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MEDICAL EXTRACTS:

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ON THE  
NATURE OF HEALTH,  
WITH  
PRACTICAL OBSERVATIONS:

AND  
THE LAWS  
OF THE  
NERVOUS AND FIBROUS SYSTEMS.

BY  
A FRIEND TO IMPROVEMENTS.

VOL. III.

A NEW EDITION.

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Homines ad deos in nullâ re propius accedunt, quam *salutem*  
hominibus dando.

CICERO.

---

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TO  
THE REV. JOSEPH TOWNSEND, M. A.  
RECTOR OF PEWSEY.

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SIR,

YOUR GUIDE TO HEALTH  
having greatly assisted this Work, independently  
of every other consideration, gives you a title  
to my acknowledgments. Accept then, Reverend  
Sir, this token of veneration, of esteem,  
and of gratitude, as well for the assistance I have  
derived from your *Medical Performances*, as for  
the information and amusement you have given  
me by your excellent Journey through Spain,  
and by your admirable Political Essays.

I have the honour to subscribe myself, &c.

*Your obedient and faithful Servant,*

&c. &c.



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OF

VOLUME III.

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PART III.

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2. Those Parts which are most supplied with *Blood Vessels* are most *sensible*.
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{ An Experiment made by Dr. BEDDOES, where VITAL AIR increased the Pain of a Blister, and relief was immediately obtained by *fixed*, and *azotic*, *Airs*.

{ Patients, who have inhaled the VITAL AIR, feel a great *Hilarity* of *Spirits*.

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1. HYDROGEN,	
2. OXYGEN,	
3. CARBON, - - - - -	ib.
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 Purposes of the SUBLIMEST CHEMIS-  
 TRY, - - - - - 387

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*Wonders*, as they seem to us, we have a beautiful Ex-  
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{ Are we staggered that a FEW PRINCIPLES, *differently*  
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*immense Variety*, - - - - - ib.

{ Here the young Student in Chemistry is reminded that,  
 1 Part *Oxygen*, with 4 of *Azotic Air*, loosely combined  
 and suspended by *Caloric*, is ATMOSPHERIC  
 AIR; whereas  
 4 Parts *Oxygen*, and 1 of *Azot*, in a State of closer  
 Combination, suspended by *Caloric*, is NITROUS  
 AIR, - - - - - ib.

{ The *Former* of which, being blended with Water, is the  
 Beverage of common Life, - - - - - ib.

{ The *Latter*, being combined with Water, is AQUAFORTIS,  
 which corrodes and destroys every Thing.—So much  
 do the *Nature of Things* depend on the *Proportions* and  
 Combinations of the FIRST ELEMENTS, - - - - - ib.

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{ And the <i>Lacteals of the Intestines</i> take in	
HYDROGEN, CARBON, AZOT, and OXYGEN, ib.	
{ The <i>just Balance of these several Principles</i> in the Body constitutes HEALTH, - - -	ib.
{ When the <i>Balance</i> gets broken, a loss of HEALTH, or DEATH, ensues, - - - -	ib.
{ When an Animal is bit by a VIPER, with the Loss of IRRITABILITY, there is a De- struction of the RIGHT BALANCE of the Principles of the Body, - - - - -	ib.

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{ The *Blood dissolved* and partly *coagulated*,  
from being *red* becomes *black* or *brown*, - 389

{ From being a *bland Fluid* contained within  
numerous Vessels, it becomes a *perfect Caus-*  
*tic*, corrupting and decomposing whatever  
it meets with, - - - - - ib.

{ The PART BITTEN goes into *immediate Putre-*  
*faction*, - - - - - 390

{ The SKIN becomes speedily *livid*, - - - ib.

{ And the MUSCLES become *black* and *fætid*, ib.

{ But the most remarkable Change is in the  
LUNGS, which is filled with *black* Blood,  
and exhibits every where *livid Spots*, - - ib.

{ This *black Appearance*, especially in the  
Lungs, would lead one to suppose, that  
the OXYGEN of the Blood, which we have  
before shewn gives it its *crimson Colour*,  
had entered into some *new State of Com-*  
*bination*, and with it, the IRRITABLE PRIN-  
CIPLE itself was fled, . - - - - - ib.

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{ A COMPARISON made betwixt the <i>Poison</i> of the <i>Viper</i> and the <i>Ticunas</i> , - - - - -	ib.
{ A strong Proof, of the <i>Tenacity</i> of Life in the <i>Viper</i> and Adder, and of the <i>superior Power</i> of the <i>Ticunas</i> , - -	ib.
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{ This important Subject deserves more consideration, and it is wished, that Dr. BEDDOES, who first brought this Subject into *repute* in ENGLAND, would examine minutely into it, and extend this principal Branch of modern Medicine, - 400

{ A Description of the ROTIFER, or *Wheel-Polypus*, - - - - - 401

{ One of these was exposed a whole Summer to the noon-day Sun, and it became so dry, that it was like a Piece of *hardened Gluc*, - - - - - 402

{ A few Drops of WATER being sprinkled on it, the *Rotifer* soon recovered Life, and all the outward Actions of Life, - - - - - ib.

{ Here the WATER when it comes into contact with the animated Fibre is decomposed, and the OXYGEN it contains combines with the Fibres of the *Rotifer*, restores to it its *Irritability*, and *Organic Motion*, of which it had been before deprived by the excessive Stimulus of Heat, - - - - - ib.

{ Thus, the *Microscopical Eels*, which are found dry and withered in smutty Wheat, are *resuscitated* effectually by the simple Presence of WATER, - - - - - 402



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{ It is said that there are venomous *Snakes* in PERU, which being to all appearance dead, and even when dried in the Smoke of a Chimney, have the Property of coming again to Life by exposure to WATER, - 433

{ The *Seta Equina* had lost almost all its Bulk and Weight, and become like a *bruised* and *dry Straw*: Its Skin had shrunk so as to leave *no sensible Cavity*; and it had no longer *any Sign of Life and Motion*, - - - ib.

{ I returned it, says FONTANA, in that State into WATER, where, in less than half an Hour, it *recovered* its *Bulk and Weight*, and soon afterwards discovered *unequivocal* and *permanent Signs of Life*, - - - - - ib.

{ I have since found, says he, a Number of other small Animals, either on the Tops of Houses, in Earths, or in Water, which, in the same way, alternately *lose* and *recover* the Use of their Organs on being dried, and afterwards immersed in WATER, - - - - - ib.

{ The fore Feet of a land Turtle was pierced with an *American Arrow*. In two Hours it appeared dead, - - - - - 405

{ After an interval of ten Hours the inner Shell was removed with all possible Care, - - - - - ib.

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{ The Heart was still, but after this Operation being moistened by *oxygenated* Blood, it recovered all its Force, and continued in strong Action for six Hours incessantly, 405

{ The fore Foot of a land Turtle was next pierced with an *American Arrow*, - - ib.

{ In eight Minutes it could *scarce move*, and in a Quarter of an Hour it was to all appearance *dead*, - - - - - ib.

{ When the FEET and NECK were stimulated, they discovered only a *slight Degree of Sensation*, - - - - - ib.

{ The HEART was *quite motionless*, and upon being touched scarcely contracted, .. - ib.

{ On freeing it of its *Membranes*, I was surprised, says FONTANA, at seeing it *move* very *briskly*, and it continued to do so for several Hours, - - - - - ib.

{ I then *covered* it with the inner Shell, and in twenty four Hours, I found it again *motionless*, - - - - - 406

{ I pricked it with a Needle, and it contracted itself once, - - - - - ib.

{ I left it *exposed* to the AIR, and in *three Minutes* it began to *move of itself*, and continued a very *brisk Motion* for several Hours, - - - - - ib.

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{ I <i>covered</i> it again with the Shell, and upon uncovering it four Hours after, I found it <i>motionless</i> , - - - - -	406
{ I then exposed it to <i>pure Air</i> , and in a short Time, and of itself, it <i>recovered</i> its <i>Oscillations</i> , which continued for six Hours, -	ib.
{ I again <i>covered</i> it with the Shell, and on uncovering it two Hours after, I found it <i>without Motion</i> , - - - - -	ib.
{ I then <i>covered</i> it with <i>Water</i> , which I kept on it for ten Minutes, without its producing any Change, - - - - -	ib.
{ I drained off the Water, and the Heart was scarcely left in <i>the Air</i> a Minute, when it began afresh to <i>move briskly</i> , and continued to do so several Hours, - - - - -	ib.
{ This <i>Succession</i> of <i>Motion</i> in the Turtle, deprived of its IRRITABILITY by the Poison of the <i>Ticunas</i> , which was produced by the simple Contact of ATMOSPHERIC AIR, if it does not decisively prove, that the IRRITABLE PRINCIPLE is the OXYGEN of the Air, it nevertheless goes to prove, that <i>the Air</i> is a very <i>active Principle</i> in awakening the IRRITABILITY of the <i>Muscular Fibres</i> and of the <i>Heart</i> , as was maintained in Sect. XXII. Vol. I. of this Work, - -	407

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## SECT. XXXVII. LAW III. A DEFECTIVE STIMULATION OF ANY ORGAN AC- CUMULATES IRRITABILITY IN THE MOVING FIBRES.

PAGE

{ The *Blood-vessels*, the *Stomach*, and *Intestines*,  
are in CONSTANT MOTION from the Stimuli  
appropriated to them, - - - - - 408

{ The *Muscles*, even when not acted upon by  
the nervous Electricity, are nevertheless in  
CONSTANT ACTION, as is seen in the *Tremor*  
of old Men, in the *Palsy of the Head*, and  
from the *Contraction* of antagonist Muscles,  
when those which counterpoise them  
are cut through, or lose *their Action* from  
some paralytic affection, - - - - - ib.

{ The IRRITABLE PRINCIPLE, therefore, is in  
*continual Action*, - - - - - 409

{ The *continued Actions* going on in organized  
animated Beings *expend* the IRRITABLE  
PRINCIPLE, whether that be OXYGEN de-  
rived from the Blood, ELECTRICITY, or  
SOME AS YET UNPERCEIVED POWER in the  
Fibre, - - - - - ib.

I. If

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I. If the SUPPLY of the IRRITABLE PRINCIPLE to the moving Fibre be <i>equal</i> to the <i>Expenditure</i> by the Action of Stimuli, the Fibre is then said to be in a State of TONE, - - - - -	409
II. If the EXPENDITURE <i>exceeds</i> the <i>Supply</i> of THIS PRINCIPLE to the Fibre, it is said to be in a State of EXHAUSTION, - -	ib.
III. But if the SUPPLY given to the moving Fibre <i>exceed</i> the <i>Expenditure</i> , the Fibre is then said to be in a State of ACCUMULATION, - - - - -	ib.

## SECT. XXXVIII. OF COLD.

{ During the Winter, by the <i>Absence</i> of the <i>Stimulus</i> of <i>Heat</i> , and in part of <i>Light</i> , <i>Plants</i> and <i>many Animals</i> become TORPID, 410	
{ In consequence of <i>this diminished Action</i> , their IRRITABILITY ACCUMULATES, which manifests itself at the return of Spring, - -	ib.
{ A slight Degree of Heat <i>then</i> produces the <i>most powerful Effects</i> upon the Fibre thus delicately <i>Irritable</i> , - - - - -	ib.
{ Dr. HALE's <i>Experiments</i> respecting the <i>Rising</i> of the <i>Sap</i> in the VINE, - - - - -	411

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The Conclusions to be drawn from his Experiments are,

I. That the Sap flows in the Vine during the SPRING, *quicker* than the Blood in the Vessels of a Horse; that its Progress is considerably *slower* in the SUMMER than in SPRING; very *languid* in AUTUMN; and *ceases altogether* in the WINTER.

II. That it is *great* in the MORNING; *diminished* at MID-DAY; and *little or none* in the EVENING.

III. That when the Vine, however, is *young* and *very vigorous*, the Sap flows *incessantly*, and *fastest* of all in the GREATEST HEAT OF THE DAY; *sinking* only after SUN-SET, - - - - 412

{ A Note to shew the Value of this last Observation, - - ib.

{ The same may be said respecting the IRRITABILITY of the *Hedysarum Gyrens*, and the *Sensitive Plant*, - - - - - 413

{ Hence it is, that the Return of Cold and Frost in the SPRING is so *noxious* to vegetables, and that THIS SEASON is generally *forward* according to the *Severity* of the *preceding Winter*, - - - - - ib.

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{ SPALANZANI observes that *Nerets* bury themselves and become *torpid*, when the Thermometer in AUTUMN is at 54; and again re-appear in SPRING, when the Thermometer is considerably below 54, - - - 414

{ FONTANA observes, that when in SPRING he exposed the Vipers that were *torpid* to the Heat of 67 Degrees *only* they *died*, though during SUMMER they bear a *much greater Degree of Heat* without the *least Injury*, - 413

{ Thus precisely it is with the *vegetable Tribe*, for they sleep in Winter, and are awakened by the vernal Sun; but die if a too powerful Heat be *suddenly* applied, - - - - 414

{ On *this Principle* we may account for the Destruction of Plants by BLIGHT in Spring; for unless there be *Frost at Night*, and on the next Day a *cloudless Sun*, there is no Blight, - - - - - 415

{ Hence if Plants be *watered* before the Rising of the Sun, they suffer *no Injury* by the *previous Frost* at this Season of the Year, - ib.

{ The *Effects* of *Winter* are therefore very great in *cold Climates*, because the ACCUMULATION of IRRITABILITY is in proportion to the Abstraction of the Stimulus of Heat, - ib.

Hence

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{ Hence Corn ripens in LAPLAND in 60 Days, whereas in FRANCE it requires 120 to 160 Days, - - - - -	415
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## SECT. XXXVIII. THE MANNER IN WHICH COLDS AND INFLAMMATORY FE- VERS ARE PRODUCED.

{ Of the <i>Cold Bath</i> , - - - - -	416
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{ The <i>Cold Bath</i> produces a great <i>quiescence</i> of the Capillaries of the Skin, the minute Vessels of the Lungs, and their various ab- sorbent Series, - - - - -	ib.
---	-----

{ From <i>their Quiescence</i> , occasioned by the want of the Stimulus of Heat, the IRRITABLE PRINCIPLE becomes ACCUMULATED, and hence a greater Quantity of Blood is trans- mitted through them, and in consequence a greater Degree of Heat ensues, - - -	ib.
---	-----

{ The Reason why the COLD BATH is fre- quently of <i>great Service</i> , - - - - -	417
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{ Of the <i>Exception</i> , and the Manner to obviate the <i>Evil</i> of COLD-BATHING, - - - - -	ib.
---	-----

{ An <i>Experiment</i> made by a healthy young Man, who first went into a <i>Cold Bath</i> , where he staid 34 Minutes, and then plunged into a <i>Warm Bath</i> at 90 Degrees, - - -	418
--	-----

Here,



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{ Here, for the first Moments, he felt *very warm*, but in two Minutes, being still in the Warm Bath, he was seized with *Shiverings*, - - - - - 419

{ When he came out of the *Warm Bath* he went to Bed, passed a very *feverish Night*, and the next Day had *wandering Pains* over his Body, with *great Weakness* resembling the *incipient Stage* of a FEVER, - ib.

{ Now, it can make little Difference, whether a Person pass from *cold Air* or *cold Water*, into *warm Air* or *warm Water*, - - - ib.

{ I have often seen, says Dr. BEDDOES, Persons who had long been riding in the *Cold* and *Wet*, experience the *first Symptoms* of FEVER upon coming into a *Warm Room*, sitting near *the Fire*, and drinking *Spirits*, - ib.

{ Dr. BEDDOES's *own Experience*, and the Manner he has *prevented* the *Accession* of FEVER, - - - - - 420

{ A singular Case arising from the *alternate Action* of *Cold* and *Heat* producing INFLAMMATION, - - - - - ib.

{ Mr. CLARKSON, in setting forth the *Impolicy* of the SLAVE TRADE, relates, that the Seamen, to make Room for these unfortunate Beings, from the Time of their leaving the Coast of Africa, sleep for the most Part on the Decks, - - - - - 421

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{ From this Exposure at Night to *Cold* and  
*heavy Dews*, and suddenly afterwards, to  
the *fierce rising Sun*, FEVERS originate  
which carry many of them off, - - - 421

{ A Description of THIS FEVER, - - - - ib.

{ Inflammations of the Eye are common in  
EGYPT, where it is the Custom during  
*Summer* to sleep in the *open Air*, - - - 422

{ Of Persons most PREDISPOSED to *this Attack*, ib.

{ Other EXAMPLES to prove, that when the  
Body has been exposed to *Cold*, it is liable  
to be much more affected by *Heat* and  
*other Stimuli*.

{ Of the Manner of treating *frozen Limbs*, - 423

{ They take *Snow* to rub the Parts benumbed  
with *Cold*, and very gradually expose them  
to a *warm Temperature*, - - - - - ib.

{ Were a *frozen Limb* to be brought before a  
*Fire*, or immersed in *warm Water*, a VIO-  
LENT INFLAMMATION would come on, and  
speedily terminate in Mortification, - - ib.

{ The Custom of first applying COLD universal-  
ly obtains in all the northern Climates, - ib.

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{ The *pungent Pain* felt upon holding one's Hand when much chilled to the Fire, is another Exemplification of the same Principle, which seems to be a general Law of animated Nature, - - - - - 423

{ By respiring a *cold Atmosphere* the same Thing happens to the Nostriils, Fauces, and Lungs, as to the external Surface of the Body upon going into a *Cold Bath*; and if we pass suddenly from such an Atmosphere into a *warm Room*, what happens to the Skin will in some Degree happen to the Membrane lining these Cavities; a GLOW or INFLAMMATION will ensue, according to the *Difference* between the two *Temperatures*, and the *Length of Time* passed in the *Cold*, - 424

{ *Children* are so susceptible of INFLAMMATION, that a great Part of the Mortality among them is to be ascribed to the *Ignorance* of Mothers and Nurses of the Power which even a moderate Change of Temperature, if suddenly made, has to effect their tender and irritable Frame, - - - - - ib.

{ A Table of DEATHS to confirm *this Assertion*, 425

{ *Three Parts* in *four* die before they have attained their full Growth, without answering any other Purpose than to give Trouble and endure Pain, - - - - - 426

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{ Does not this arise from something *wrong* in our Management, or is the human Frame so weakly contrived and executed? - - 426

{ If then *the Management* of our Children be *wrong* in any very material Point, may not a *Stop* be put to THIS EXCESSIVE MORTALITY? - - - - - ib.

{ One may, with the greater Propriety, disseminate the Knowledge, "HOW COLDS, FEVER, RHEUMATISMS, ETC. ARE CAUGHT," as this is far from being generally understood even by the Members of the Medical Profession themselves, - ib.

{ If this is thought to be a wanton paradoxical Assertion, he may find in the Case of *Opium*, and of the *cool Treatment* of the *Small-pox*, Instances equally striking, of one Generation of Pathologists passing away after another imbibing the same Errors, so servilely imitative an Animal is Man! - - 427

{ Few *Climates* are so *changeable* as our own, - ib.

{ We frequently find a *cold* and *keen Day* succeeded by one as *mild*, or even as *warm* as *Summer*; or, what is worse, the *Forenoon* is accompanied with a *sharp, dry, north-east Wind*, and the *latter Part* of the *Day* is *uncommonly warm*, - - - - - ib.

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{ It is impossible, but that this *sudden Change*  
from *Cold* to *Heat*, must, in delicate Con-  
stitutions especially, be productive of Mis-  
chief, - - - - - 427

{ The *Constitution* has Powers of ADAPTING IT-  
SELF to *these Changes*, if they be *gradual*, 428

{ Thus we bear *without Injury* the *Heat* of  
SPRING after the *coldest* WINTER, - - ib.

{ But where the *Change* is *more violent* than in  
the Transition from one Season to another,  
as when *Europeans* go to the *East* or *West*  
*Indies*, the Effect is strongly marked, - - ib.

1. The CIRCULATION becomes *quicker*.

2. The PERSPIRATION *freer*.

3. A LASSITUDE or DEBILITY takes  
*place*.

4. The SECRETION of Bile is increased, &c.

{ In short *more* or *less* of FEVER is produced,  
which *varies* in different People according  
to Circumstances, and *continues* until the  
*increased Force* of the Heart and Arteries,  
kept up by the *accumulated Irritability* of  
the System, from the previous Effect of  
Cold, *ceases*; that is, until the IRRITABI-  
LITY OF THE FIBRE and the EXTERNAL  
STIMULUS be *properly adjusted*, - - - 429

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{ It has been before observed, that if the Hand  
has been exposed to *Snow*, and afterwards  
suddenly brought to the *Fire*, a VIOLENT  
INFLAMMATION would ensue, - - - 430

{ So when a Person is out in very *cold Weather*,  
the Air, every Time he draws his Breath,  
brushes his Nostrils, Wind-pipe, and  
Lungs; and just as is the Case with the  
*outward Skin*, it makes *these Parts* more  
liable to be INFLAMED by *Heat*, - - - 431

{ A COLD, therefore, is nothing more than  
an INFLAMMATION of THE CHIL-  
LED PART, which is the *smooth moist*  
*Skin* which lines the *Nostrils* and goes down  
the *Wind-pipe* into the *Lungs*, - - - ib.

{ While we are exposed to *Wet* or *Cold* there  
is *no Tendency* to INFLAMMATION, but it is  
the *subsequent Heat*, *Exercise* in *changing*  
our *Garment*, or *Stimulants*, which produce  
the GLOW, or INFLAMMATION, - - - 432

{ The Manner in which a *Cold* may be a-  
voided, - - - 433

{ Of the POPULAR TREATMENT of *Colds*, and ITS DAN-  
GERS set forth, - - - ib.

{ The Reason why the *antiphlogistic Treatment* should always  
be preferred, - - - ib.

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## SECT. XXXIX. OF DARKNESS.

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{ The Stimulus of LIGHT is <i>favourable</i> to - <i>Health</i> , - - - - -	434
{ In <i>asthenic Diseases</i> it is <i>particularly service-</i> - <i>able</i> , - - - - -	ib.
{ The Effect that the <i>Window-tax</i> has had on - the Health of Individuals, - - - - -	ib.
{ This was observed by the philanthropic Mr. HOWARD, -	ib.
{ It is right to stir up HUMANITY in the Cause of <i>suffering</i> - <i>Nature</i> , and to point out the <i>Evils</i> inflicted by the <i>Go-</i> - <i>vernors</i> on the <i>Governed</i> ; and since even a <i>bad Govern-</i> - <i>ment</i> is, comparatively speaking, a <i>Blessing</i> , to occasion - it to be so <i>administered</i> as to make it the FIRST OF - BLESSINGS, - - - - -	ib.
{ To shew that IRRITABILITY is ACCUMULAT- - ED by the Absence of Light, GIRTANNER - enveloped the Leaves of the <i>Mimosa</i> in an - <i>opaque Body</i> , so that the Light could not - penetrate, and he found all these Leaves - became <i>considerably more irritable</i> than the - rest, - - - - -	435
{ Animals living near the <i>Arctic Circle</i> grow - <i>white</i> , - - - - -	ib.
{ The same may be observed of Animals that - inhabit the <i>Alps</i> , - - - - -	ib.



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{ Mice kept in a Cage in a dark Room produce <i>white Mice</i> , - - - - -	435
{ Men as they recede from the Line are proportionably <i>fair</i> , - - - - -	ib.
{ The <i>Irritability</i> is found to correspond with <i>these Shades</i> , - - - - -	436
{ In every Climate CHILDREN are born <i>fair</i> , and become darker as they advance in Life, - - - - -	ib.
{ The <i>soft flaxen Hair</i> inclining to <i>red</i> , and the <i>blue Eye</i> , denotes an IRRITABILITY of Temperament, - - - - -	ib.
{ The <i>curled black</i> and <i>strong Hair</i> , with a <i>black Eye</i> , shews a <i>stronger Fibre</i> with less IRRITABILITY, - - - - -	ib.
{ <i>Blunched Plants</i> are incapable of supporting a great Quantity of Light, - - - - -	437
{ In the <i>white Negro</i> born of black Parents exhibited in London, - - - - -	ib.
1. The <i>Hair</i> was of a <i>Silver white</i> .	
2. The <i>Eye</i> was so <i>impatient</i> of the Stimulus of <i>Light</i> , that it was almost in constant Action.	
3. She had even <i>lost</i> one <i>Eye</i> .	

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4. Her Son was subject to *scrophulous Tumours* in the Neck, and was a *Mulatto*, though her Husband was a white Man, - - - - - 437

{ From the *excessive Irritability* of the optic Nerve the *white Negroes* are incapable of enduring a *Glare* of Sun, and only enjoy his *reflected Rays* from the Moon, - - - ib.

{ Hence they are called MOON-EYED, - - - ib.

{ These are principally found in *America*, - - - ib.

{ They are universally described by all Travel- lers, as a Race of *low Stature*, of a *feeble Make*, and *unable* to support the *slightest Fatigue*, - - - - - ib.

{ There is now at *Exeter Change* a Man born of black Pa- rents, who is directly *pie-balled*, - - - - - ib.

{ 1st. Query. Would THE TRADERS IN HUMAN FLESH feel some conscience in selling the *white Negro Woman*? - - - ib.

{ 2d. Query. On which Side would the Balance of Opinion preponderate with them with regard to the *pie-balled Man*, - - - - - ib.

{ It is melancholy to observe the Pains some *white Men* have been at to represent the *black Race* as a lower Species of Animal;—to confound them with the Monkey;—or if Men, to degrade them into Beings destined by a benevo- lent and superintending PROVIDENCE to become the Slaves of such as boast the Names of *Christian* and *Eu- ropean*, - - - - - 438

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{ If they are <i>uncivilized</i> , it is you who have plunged them deeper in their Darkness, - - - - -	438
{ If their Country is <i>unfruitful</i> , it was <i>once</i> the chief Resource of <i>Rome</i> , - - - - -	ib.
{ If <i>barbarous</i> in the Extreme, you have set them a still more barbarous Example, - - - - -	ib.
{ And if it shall be said, that the 18th <i>Century</i> was an <i>enlightened Period</i> , YOUR DEEDS will be adduced to <i>disprove the Assertion</i> . Vide Part I. p 54: also Note †, p. 56. - - - - -	ib.

## SECT. XL. OF SLEEP.

{ More than <i>one Third</i> of the Life of Man is consumed in the irrational State of <i>Sleep</i> , -	439
{ The <i>Wisdom</i> of the AUTHOR of NATURE, however, is manifest in this <i>seeming Imperfection</i> of his Work, - - - - -	ib.
{ According to Dr. JOHN BROWN,	
I. <i>Life</i> is a <i>forced State</i> , - - - - -	ib.
II. <i>Every animated Being</i> has only a <i>certain Portion</i> of the IRRITABLE PRINCIPLE, - - - - -	ib.
III. <i>Every Power</i> that acts upon the <i>living Frame</i> is STIMULANT, or produces <i>Excitement</i> by <i>expending</i> IRRITABILITY, - - - - -	ib.

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IV. The Application of <i>Stimuli</i> after a certain Time <i>exhausts</i> the IRRITABILITY or EXCITABILITY of the System,	440
V. To recruit <i>which Loss</i> , the <i>all-wise</i> and <i>merciful</i> CREATOR has instituted the Season of SLEEP, - - - - -	ib.
{ This <i>System</i> of BROWN is compared to <i>Combustion</i> , - -	ib.
{ Dr. BROWN conceived, that to <i>each Individual</i> there was allotted only a <i>certain Portion</i> of the IRRITABLE PRINCIPLE from the <i>Commencement</i> of its animate State, - - - - -	ib.
{ The Reader will now understand, why <i>Food, Drink, Air</i> , &c. though <i>they support Life</i> , yet <i>consume it</i> ; for he will see, that the <i>Application</i> of <i>these Powers</i> , though they <i>bring forth Life</i> , consume the EXCITABILITY or MATTER OF LIFE, just as <i>Air</i> blown into the Fire <i>brings forth more Flame</i> , but <i>wastes the FUEL</i> , or MATTER OF FIRE, - - - - -	ib.
{ This is conformable to the common Saying, the more a <i>Spark</i> is blown, the <i>brighter it burns</i> , and the <i>sooner</i> it is <i>spent</i> , - - - - -	ib.
{ Common, or ordinary, Sleep, therefore, from what has been said, seems to be a State, which takes place in order to <i>restore</i> the EXCITABILITY of the System, which has been <i>expended</i> by the Application and Action of Stimuli.	

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{	During <i>Sleep</i> ,	
	1. The Stimulus of VOLITION is suspended, - - - - -	441
	2. The Stimuli of EXTERNAL OBJECTS. is excluded by the <i>Silence</i> and <i>Darkness</i> of the Night, - - - - -	ib.
	3. Even CATHARTICS lose <i>their Power of Action</i> , - - - - -	ib.

{	While ATMOSPHERIC AIR is almost the only external Power, which then continues to be applied, at once carrying off what is <i>excrementitious</i> from the Lungs, as it affords probably to the System THAT PRINCIPLE, which is <i>expended</i> by the <i>various Actions of Life</i> , - - - - -	ib.
---	--	-----

{	And as COLD <i>accumulates</i> the Irritability of the Fibre, it is wisely fore-ordained that this Season shall be accompanied with a suitable Degree of <i>Cold</i> , - - - - -	ib.
---	--	-----

{	Besides the very great quantity of the IRRITABLE PRINCIPLE perpetually <i>expended</i> in moving the <i>arterial, venous, and absorbent Systems</i> , as described Vol. I. p. 441. There is also, during our waking Hours, a <i>constant Expenditure</i> of IT by the ACTION of our <i>locomotive Muscles and Organs of Sense</i> , 442	
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It

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{ It follows, <i>therefore</i> , that if the <i>Exertion</i> of these Organs of Sense and Muscles be for a while <i>intermitted</i> , that a <i>large Quantity</i> of the IRRITABLE PRINCIPLE must be <i>accumulated</i> , - - - - -	443
{ NUTRITION is probably carried on <i>during Sleep</i> , - - - - -	444
{ The Reason why SWEATS are so likely to break out towards Morning, - - - -	ib.

## SECT. XLI. SOME PRACTICAL OBSERVATIONS.

{ The Reason why we ought to go to Bed and rise up in the Morning at a <i>regular Hour</i> , - - - - -	445
{ The End of SLEEP is to regain <i>that Irritability</i> , which has been <i>expended</i> by the <i>Exertions</i> of the preceeding Day, - - - -	ib.
{ The Chamber in which we sleep ought therefore to be,	
1. <i>Silent</i> , - - - - -	ib.
2. <i>Dark</i> , - - - - -	ib.
{ And 3. <i>Moderately Cold</i> , - - - - -	ib.

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{	We should not sleep surrounded with <i>Curtains</i> .	
{	1. Because the OXYGEN or VITAL AIR, imbibed by the Lungs, if not THE PRINCIPLE, favours at least the <i>Recovery</i> of IRRITABILITY, - - - -	ib.
{	And 2. Because it makes up part of the <i>digestive Process</i> , which chiefly goes on during Sleep, - - - - -	ib.
{	<i>Snoring</i> arises from impure AIR in the Chamber, more commonly than from any Defect in the Organs destined to draw in the Air for the proper Change of the Blood, - -	ib.
{	The <i>Poor</i> exhausted by their Labour go to Bed early, get up at Sun-rise, and <i>accumulate</i> fresh IRRITABILITY by the <i>Coolness</i> of the Morning, - - - - -	446
{	The <i>blooming Complexion</i> of the Peasantry compared with the <i>sickly Visage</i> of the Sons of Luxury, who turn <i>Night</i> into <i>Day</i> , and <i>sleep</i> in <i>Beds of Down</i> , clearly demonstrates which Mode of Life is most conducive to HEALTH, - - - - -	ib.
{	Those, who sit up at Night, and sleep late in the Morning, hurt their Constitutions <i>without gaining Time</i> , and ought not to repine at a <i>fashionable State of bad Health</i> , -	ib.

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{ *Study* protracted far into the Hours of Night,  
*Cares* harboured, and even very *late Hours*  
in COMPANY, by encroaching on the Hours  
adapted for Sleep, are sure to lay the  
Foundation of many dreadful Diseases, - 447

{ The EFFECTS which arise from *Want* of  
*Sleep*, - - - - - ib.

{ King HENRY's *Soliloquy*, - - - - - 448

{ It is thought by the Greek Poet *unnatural* for  
a King to enjoy a *whole Night's rest*, - - 449

{ Lord LYTTLETON's *Death* ascribed to a *Want*  
of *Sleep*, - - - - - 450

{ The *Character* of this Nobleman, - - - - - ib.

{ The Studious ought to limit their learned  
Labours to *proper Hours*, and all others are  
advised to *solicit Sleep* by a *seasonable Dis-*  
*missal* of *Business* and *Care*, - - - - - ib.

## SECT. XLII. OF IMPURE AIR.

{ As *Sleep* arises from the *Exhaustion* of the IR-  
RITABLE PRINCIPLE, it is procured,  
1. By *Fatigue* from muscular or mental  
Exertion, - - - - - 451  
2. By *increasing* the *Action* of the System  
by other Stimuli, - - - - - ib.  
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3. By <i>Sounds</i> , which divert the Mind from Volition, - - - - -	452
And 4. By the <i>Abstraction</i> in part of the Stimulus of <i>Oxygen</i> from the Air, -	ib.
{ A Note to shew that the <i>new Chemistry</i> has not introduced idle and ridiculous <i>Speculations</i> , - - - - -	453
{ An Enumeration of the Physicians, and other Gentlemen of literary Education, who have united in favour of the <i>factitious Airs</i> , and other <i>Substances</i> , of which the Appli- cation to Medicine has been suggested by <i>modern philoso- phical Discoveries</i> , - - - - -	ib.
{ Dr. CRAWFORD, the celebrated Author of a Work on animal Heat, is a new Accession of Strength, - - -	ib.
{ He became a Patient to Dr. THORNTON, and inhaled the <i>Hydrocarbonate</i> , - - - - -	ib.
{ The <i>Effects</i> which <i>this Air</i> had on Dr. CRAWFORD, - -	ib.
{ The Experience of Dr. BEDDOES, in which he is able to induce <i>Sleep</i> almost at will by means of the <i>Hydrocarbonate</i> , - - - -	ib.
{ The ANALOGY which there is between <i>Sleep</i> , and the State of <i>Torpor</i> in dormant Animals, - - - - -	454
{ <i>Cold</i> puts all Animals of this Class to <i>sleep</i> , except the MARMOT, - - - - -	455
{ THIS ANIMAL closes up the Aperture of his subterraneous Dwelling, and <i>then</i> it be- comes <i>torpid</i> , - - - - -	ib.

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{ Though exposed to a Cold equal to that of Freezing, while in the <i>open Air</i> he remains unaffected, - - - - -	456
{ Does not the stagnant Air of the Cell, deprived in part of <i>Oxygen</i> , and superfaturated with <i>fixed Air</i> from his Breathing, produce, together with the <i>Cold</i> , the State of TORPOR? - - - - -	457
{ The <i>Bees</i> which were carried to JAMAICA, as they are not confined by Cold, ceased to make Honey after the first Year, and have become very troublesome, - - - -	455
{ In cold Climates, if the Weather is sufficiently severe, <i>Bees</i> become <i>torpid</i> , and <i>do not consume</i> their Provision, - -	457
{ If the Weather is not sufficiently cold they <i>consume</i> their Winter's Store, - - - - -	ib.
{ Might not an Experiment with a reduced Atmosphere turn out of <i>twofold Advantage</i> with respect to <i>Bees</i> ? - - -	ib.
{ The Manner in which these torpid Animals are to be <i>re-animated</i> , - - - - -	456
{ The Symptoms which arise from a sudden and forced Re-animation, - - - - -	ib.
{ Vegetables throw out AZOTIC AIR during the Night, - - - - -	457

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{	During the Day they emit VITAL AIR, and imbibe FIXED AIR, which arises from Respiration and Combustion, so admirable is the <i>reciprocal Intercourse</i> betwixt the <i>animal</i> and <i>vegetable Kingdoms</i> , - - - - -	457
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## SECT. XLIII. OF REST.

{	<i>Wakefulness</i> compared to <i>Exertion</i> , and <i>Sleep</i> to <i>Rest</i> , - - - - -	459
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{	From voluntary <i>Exertion</i> , the <i>Will</i> gets fatigued by the <i>Expenditure</i> of the SENSORIAL POWER, as the <i>Muscles</i> do by the <i>Expenditure</i> of the IRRITABLE PRINCIPLE, - -	ib.
---	---	-----

{	Every one has experienced the Refreshment arising from <i>Repose</i> , and it is an established Fact, that for a Horse to perform a long Journey, he should be previously kept at <i>Rest</i> for several Days in the Stable, - -	460
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{	We <i>stretch our Limbs</i> after profound Sleep from the <i>Accumulation</i> of the IRRITABLE PRINCIPLE in the Fibres, - - - - -	ib.
---	---	-----

{	From the SAME CAUSE we <i>yawn</i> , when the Muscles of our Face has been long in a State of <i>Inaction</i> , - - - - -	ib.
---	---	-----

{	CHILDREN, who have <i>abundant Irritability</i> , are never <i>easy</i> but in a <i>Change of Position</i> , -	ib.
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After animal Fibres have for some Time been exerted into <i>Contraction</i> , a <i>Relaxation</i> succeeds, even though the exciting Cause continues to act.	
1. <i>a.</i> In our <i>muscular Exertions</i> it is experienced, as no one can hang long by the Hands, however vehemently he wills to do so, - - - - -	461
<i>b.</i> And the Changes of our Attitude evinces the Necessity of Relaxation to those Muscles which have been long in action.	
2. In respect to the <i>irritative Motions</i> this is exemplified in the peristaltic Contractions of the Bowels, and the Beatings of the Heart, which cease and are renewed alternately, though the Stimulus of the Aliment and Blood continue to be uniformly applied, - - - - -	460
3. In <i>sensative Motions</i> , as in Fits of the Stone and Gravel, and in Parturition, though the Stimulus is perpetual, - - - - -	461
{ Dr. DARWIN's Term SENSORIAL POWER explained, -	ib.
{ By the Motion of a Fibre the IRRITABLE PRINCIPLE becomes <i>expended</i> , and the Fibre, as was said before, ceases to act,	
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{ though the Stimulus be applied ;—till in a certain Time the Fibre has *received* a *due Supply* of the IRRITABLE PRINCIPLE, when it becomes again ready to contract from the *same Stimulus*, - - - - - 461

{ If this Stimulus be withdrawn for a Time, the IRRITABLE PRINCIPLE becomes *accumulated*, and contracts with *equal Energy* from the Action of a *weaker Stimulus*. Or if an *equal Stimulus* be applied, it is thrown into *more violent Action*, - - - 462

1. Thus a State of *Sleep* subsisting for some Time induces a State of the System more ready to be affected by Stimuli of all Kinds. Vide Cullen's *Materia Medica*, Vol. II. - 446

2. *a.* Thus if the Stimulus of Heat be withdrawn by covering the Hands with *Snow*, the IRRITABLE PRINCIPLE, which had habitually been supplied to the Fibres, becomes now *accumulated* in them, owing to the Want of its being expended by their accustomed contractions; and thence a less Stimulus of Heat will now excite them into violent Contraction, - - - - - ib.

*b.* Thus on a *frosty Day* with a *bleak Wind*, the Face of a Person exposed to



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to the Wind is at first pale and shrunk: But on turning the Face from the Wind, it becomes soon of a Glow, with Warmth and Flushing, - - - - - 463

c. The Glow of the Skin on emerging from a *Cold Bath* is owing to the same Cause; for by lessening the Quantity of Heat for a Minute or two by going into the Cold Bath, a great *accumulation* of the IRRITABLE PRINCIPLE is necessarily produced. On emerging from the Bath the irritable Fibre is therefore thrown into greater Excretion by the Stimulus of the Warmth of the Atmosphere, and a great Increase of animal Heat ensues, - - - ib.

{ These Examples present us with the Phenomena of a FEVER FIT; for the *Hot-fit* of intermittent Fevers are in consequence of the previous *cold Ones*, - - - - - ib.

{ The *Symptoms* of Fever may be explained upon THIS PRINCIPLE.  
1. The *Cold-fit*, - - - - - 464  
2. The *Hot-fit*, - - - - - 466

{ The *Cure* of Intermittents also depends upon THIS PRINCIPLE, - - - - - 468



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Sometimes however the IRRITABLE PRINCIPLE does not <i>accumulate</i> from <i>Inertion</i> , as was explained,	
1. Respecting the <i>Cold Bath</i> , p. 417, - - - -	467
And as will be seen in the Section treating on,	
2. <i>Hydrothorax</i> , Water in the Chest, - - - -	ib.
3. <i>Anasarca</i> , general Dropsy, - - - -	ib.
4. <i>Typhus</i> , putrid Fever, - - - -	ib.
In these three last Instances the <i>Inertion</i> arose from the <i>Exhaustion</i> of the IRRITABLE PRINCIPLE, as was explained in <i>Law II.</i> p. 361, - - - -	ib.

## SECT. XLIV. OF HUNGER.

There are <i>three Classes</i> of Readers.	
1. Those who seek to find in a Work the <i>Agreeable</i> with the <i>Useful</i> , - - -	469
2. Those who are pleased only with the <i>Profitable</i> , - - - -	ib.
3. Those who read in order that they may not appear <i>ignorant</i> of the Contents of any popular Work, - - - -	ib.
These <i>three Classes</i> of Readers will find their Account in this Work, - - - -	ib.
For the <i>first Class</i> of Readers this Work was designed, - - - -	ib.
The <i>second Class</i> , by reading the Table of Contents, may turn easily to those practical Points they wish only to see discussed,	ib.
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{ And the *Third*, by reading the *Analysis* in the  
Table of Contents, may know the Sub-  
stance of the whole Work in a few Hours, 469

{ THIS ANALYSIS, however, was intended  
merely to *refresh* the *Memory* of the *first*  
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{ The *Narrative* of Captain BLIGH's *Voyage*, - ib.

{ The Reason why a *full Account* of the Suf-  
ferings and Escape of Captain BLIGH is  
given to the Readers, - - - - - 470

{ The APOLOGY to such as wish for an *abridg-*  
*ed View*, - - - - - ib.

{ The *Object* of the *Voyage*, was to transport  
the BREAD-FRUIT Tree from the *Society*  
*Islands* to the *West Indies*, - - - - - ib.

{ A Description of the BREAD-FRUIT, - - - - - ib.

{ Its *vast Importance*, and the Manner in which it is pro-  
duced, - - - - - ib.

{ The Ship was named BOUNTY, - - - - 471

{ The *Cabin* appropriated to the BREAD-FRUIT  
was contrived by Sir JOSEPH BANKS, - - ib.

{ It was *completely fitted out* by GOVERNMENT, ib.

{ The *Commands* of the ADMIRALTY, - - - 472

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{ After a ten Months Voyage this Ship arrived safe at <i>Otaheite</i> , - - - - -	476
{ The <i>friendly Reception</i> Captain BLIGH and his Men met with from the Natives, - - -	ib.
{ Many Enquiries are made after Sir JOSEPH BANKS and Captain COOK, - - - -	477
{ OMAI and the two New ZEALAND BOYS whom Captain COOK left on the Island were <i>dead</i> , - - - - -	478
{ Some of the <i>Products</i> of Captain COOK's Voy- age was brought Captain BLIGH, as <i>Pum-</i> <i>kins, Goats, &amp;c.</i> - - - - -	ib.
{ Also Captain COOK's <i>Picture</i> , painted by WEBBER, and which he left there in 1777, desiring it to be shewn to Strangers as a Token of Friendship, - - - - -	ib.
{ OTOO comes the next Morning on board, -	479
{ The <i>customary Mode</i> of SALUTATION, - -	ib.
{ Captain BLIGH <i>fires</i> the <i>great Guns</i> , and as the Shot fell into the Water the Natives express their Approbation by loud Shouts and Acclamations, - - - - -	480
{ A <i>Description</i> of OTOO, who had taken the Name of TINAH, and of his Wife IDEAH, ib.	

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{ OF WHYDOAH, the younger Brother of TINAH, - - - - -	480
{ HE has the Reputation of being a <i>great War-</i> <i>rior</i> and <i>Drunkard</i> , - - - - -	ib.
{ TINAH, as being a superior Chief, is <i>fed</i> by Attendants, - - - - -	481
{ He excelled as much in <i>Eating</i> as the other did in <i>Drinking Ava</i> , - - - - -	ib.
{ The Men dine <i>separate</i> from the Women, -	ib.
{ TINAH, <i>besides</i> dinner, eat during the After- noon <i>five Times</i> of Pork, - - - - -	ib.
{ The <i>Visit</i> of TINAH is <i>returned</i> by Captain BLIGH, - - - - -	ib.
{ After making a Present to TINAH, he gave several small Trinkets to the Children in Arms, - - - - -	482
{ The pleasant Drollery of these People, - -	ib.
{ The <i>Conversation</i> which passed betwixt TI- NAH and Captain BLIGH, - - - - -	483
{ He obtains the Promise of a Present of BREAD-FRUIT for the EAREE NO BRITAN- NEE, or <i>Chief of Great Britain</i> , - - -	ib.
{ Three of Captain BLIGH's men <i>desert</i> , and carry away with them the Cutter, - -	485
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{ They deliver up themselves to Captain BLIGH, being much harassed by the Na- tives, who were constantly watching an opportunity to surprize them, - - - -	486
{ In a Day or two after, the <i>Cable</i> was cut nearly asunder, - - - - -	487
{ Captain BLIGH expressed <i>great Indignation</i> against the Natives, - - - - -	ib.
{ The chief Families retire through Fear to the Mountains in the midst of heavy Rain, -	488
{ The Reasoning of Captain BLIGH on this Event, - - - - -	489
{ The <i>Object</i> of the Voyage was now fulfilled, and 1015 BREAD-FRUIT Plants, in a flour- ishing Condition, were put on board, besides <i>several other Fruits</i> , - - - -	ib.
{ The Chiefs of the Island dine with Captain BLIGH, who is loaded with a Variety of Things from the Natives, - - - - -	490
{ In the Evening, the <i>Departure</i> of Captain BLIGH being announced, there was no <i>Dancing</i> or <i>Mirth</i> on the Beach as was the Custom, but all was <i>mournful Silence</i> , - -	ib.

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{ The DEPARTURE from <i>Otaheite</i> , - - - -	491
{ All <i>at present</i> was <i>Prosperous</i> , but very soon a different Scene took place, - - - -	ib.
{ An <i>Account</i> of the SECRET CONSPIRACY that was formed to feize the Ship, - - - -	492
{ The <i>cruel Treatment</i> that Captain BLIGH met with from the <i>Mutineers</i> , - - - -	ib.
{ He is <i>seized</i> while <i>asleep</i> in his Cabin, <i>hand-</i> <i>cuffed</i> and <i>threatened</i> with <i>instant Death</i> , -	ib.
{ Captain BLIGH's <i>magnanimous Behaviour</i> at this Moment, - - - -	ib.
{ The PROGRESS of the <i>Mutiny</i> , - - - -	493
{ The <i>Conduct</i> of the <i>Mutineers</i> during this Transaction.	
{ The <i>furious Behaviour</i> of CHRISTIAN, - -	492
{ The <i>Mutineers</i> force Captain BLIGH and <i>eighteen</i> of his Men into a small Boat twenty Feet in Length, and turn them adrift into the open Ocean, - - - -	493
{ They <i>laugh</i> at the <i>helpless Situation</i> of the Boat, - - - -	497
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{ CHRISTIAN shewed at last some Signs of Re- morse, - - - - -	500
{ The Cry of HUZZA FOR OTAHEITE was fre- quently heard among the Mutineers, -	501
{ The <i>Reason</i> of this Disaffection, - - -	502
{ The <i>chief Cause</i> must be attributed to the Wo- MEN of <i>Otaheite</i> , - - - - -	502
{ The <i>Influence</i> which <i>Modesty</i> had over rude Minds in this Instance is very striking, - - - - -	502
{ They imagined they should become fixed in the midst of Plenty on one of the finest Islands in the World, - - - - -	503
{ They were encouraged also by the Natives, -	ib.
{ Hence <i>Desertions</i> were frequent from most of the Ships, which have gone to the <i>Society</i> <i>Islands</i> , - - - - -	504
{ The <i>Secrecy</i> of the Mutiny was beyond Con- ception, - - - - -	ib.
{ Neither Captain BLIGH, nor any of the Men with him, had the smallest Conception of it, though they had lived upon Terms of the greatest Intimacy with some of the Mutineers, - - - - -	505

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{ Captain BLIGH and his Men row towards <i>Tafoa</i> , - - - - -	505
{ On this Island there is a <i>Volcano</i> , which is constantly burning. Here they could not find any other Signs of Inhabitants than a few desolate Habitations, - - - - -	507
{ The whole Country seemed covered with Lava, and had a most dreary Appearance, ib.	
{ There was a <i>Cave</i> in this Island, where part of Captain BLIGH's Crew slept, to give the others Room, who were in the Boat, - -	508
{ The Night was passed free from Danger, and in the Morning some of the Natives came to them and traded in a very <i>peaceable</i> <i>Manner</i> , - - - - -	510
{ The Spirits of every one was revived, and they no longer regarded Captain BLIGH with those anxious looks, which had con- stantly been directed towards him since they lost Sight of the Ship, - - - -	ib.
{ The Natives flocked in great Numbers from all Quarters of the Island, and soon exhi- bited an <i>hostile Intention</i> , - - - - -	511
{ They knocked <i>Stones</i> together, which was the Sign of an Attack, - - - - -	ib.

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{ Captain BLIGH remained in this Cave during the Day, and towards *Sun-set* every Person taking with him his Proportion of Things retreated towards the Boat, - - - - 513

{ The Chiefs eagerly asked of him, " Whether he did not intend sleeping in the Cave, as on the preceding Night," - - - - ib.

{ The Answer being in the *Negative*, the elder Chief started up, and said, If you do not mean to sleep on Shore to Night, then "*Mattie*," which means, *we will kill you instantly*, and immediately withdrew, - ib.

{ The *Onset* was now preparing, - - - - ib.

{ Every one made a Noise with the Stones he held in his Hand, and the other Chiefs ran away, one of whom forcibly wrested himself from Captain BLIGH, - - - - ib.

{ While Captain BLIGH (who remained the last on Shore with the Carpenter) was hauling into the Boat, one of his Men undauntedly ran up the Beach to cast the Stern-fast off, notwithstanding the others called to him to return, - - - - 514

{ The Attack was now begun by about *two hundred* Men, - - - - ib.

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{ The <i>unfortunate Sailor</i> on the Beach was soon knocked down, - - - - -	514
{ Many Indians got hold of the <i>Stern-rope</i> , and were hauling the Boat on Shore; but for- tunately Captain BLIGH had a Knife in his Pocket, with which he cut the Rope, or otherwise they had effected their Pur- pose, - - - - -	ib.
{ Seeing the Boat row off, they fill their Canoes with Stones and renew the Attack, - -	ib.
{ Captain BLIGH adopted the Expedient of throwing overboard <i>some Clothes</i> , which fortunately they stopt to pick up, - -	515
{ It then became <i>dark</i> , and they gave over the Attack and returned to Shore, - - -	ib.
{ The <i>Reflections</i> which this Event gave rise to,	ib.
{ They request Captain BLIGH to take them Home, - - - - -	516
{ The Provisions being examined, the Allow- ance was <i>an Ounce of Bread</i> and a <i>Quarter</i> of a <i>Pint of Water</i> PER DAY for each Man,	ib.
{ They experience a <i>great Storm</i> , - - - -	517

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{ The Sea broke over the Boat, and the Bread they had would have been spoilt, had they not fortunately had a *Chest*, which the Carpenter had secured, when the Mutiny took place, - - - - - 517

{ The dreadful Situation they were in from *Cold* and *Hunger*, and the EFFECT that one *Tea-spoonful* of *Rum* had on these famished Persons, - - - - - 518 & 522

{ An Account of the Voyage, and the Distresses they experienced, - - - - - 519

{ The Crew are amused by Captain BLIGH's Description of the Situation of *New Holland* and *New Guinea*, - - - - - 522

{ *Very little Sleep* was procured, and that by no means *refreshing*, - - - - - ib.

{ It rained continually, - - - - - ib.

{ The Manner in which the Evil of *wet Clothes* was obviated, - - - - - ib.

{ *Extra-Allowance* is requested, and refused, - 526

{ The *Joy* that was exhibited, when any one was to have a *Tea-spoonful* or *two* of *Rum*, 527

{ EXTREME HUNGER was now very apparent, but no one suffered from *Thirst*, - - - ib.

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{ <i>Cramps</i> and <i>Pains</i> always succeeded <i>Sleep</i> , -	528
{ <i>SLEEP</i> afforded <i>no Relief</i> , and Captain <i>BLIGH</i> says, for his Part, " <i>he almost lived with-</i> <i>out it</i> ," - - - - -	ib.
{ Their Situation became now very distressing,	529
{ The Sun for the first Time for fifteen Days shone out, and the Sea was calm, - -	ib.
{ The <i>Allowance</i> is <i>abridged</i> , and Supper omit- ted, - - - - -	530
{ Some <i>Noddies</i> were caught, and divided into 18 Portions, - - - - -	531
{ The <i>Symptoms of Disease</i> that univerally ap- peared, - - - - -	ib.
{ Among the rest there was no <i>alvine Exono-</i> <i>ration</i> , - - - - -	532
{ The same was mentioned by <i>BETSY CANNING</i> , who was confined in a Loft, by a gipfy Woman, at <i>Enfield Wash</i> , and lived three Weeks on a <i>Loaf</i> and a <i>Pitcher of</i> <i>Water</i> , - - - - -	ib.
{ Another Instance of the <i>same Symptom</i> recur- ring is mentioned in this Work, - - -	550
{ They at length reach the Coast of <i>New Hol-</i> <i>land</i> , - - - - -	552

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{ They land and find Plenty of Oyſters and fresh Water, - - - - -	533
{ The <i>Alarm</i> that was excited which occasion- ed a <i>Suſpicion</i> of POISON, - - - - -	ib.
{ <i>Intoxication</i> was excited, - - - - -	ib.
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{ In this State, the Animal remained *three Quarters of an Hour*, during which Time the Air had access to the Lungs, - - - 619

{ The Cord being now shifted *below the Opening* into the *Wind-pipe*, so as to intercept the Ingress of Air into the Lungs, the Animal was completely dead in a *few Minutes*, - - - - - ib.

{ Hence it follows, that the *proximate Cause* of *Death* in HANGING is the want of VITAL AIR in the BLOOD, - - - - - ib.

{ The *Plan of Treatment* is therefore the *same* as in *Asphyxia* from *Drowning*, - - - - - ib.

## SECT. LI. OF ASPHYXIA FROM MENTAL AGITATION.

{ In EXCESSIVE FRIGHT,  
 1. The EYES flash *Fire*.  
 2. The HAIR becomes *Electric* and *stands erect*.  
 3. The HEART *palpitates*.  
 4. The BODY is thrown in the *Attitude* for *escaping*, - - - - - 620

{ These Appearances denote a *great Analogy* betwixt the *nervous* and the *electric Fluid*, ib.

Sir

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{ Sir ISAAC NEWTON's <i>Supposition</i> on this Head, - - -	620
{ When the DANGER is INEVITABLE.	
1. <i>Cold Sweats</i> succeed.	
2. The <i>Hair</i> of the Body <i>droops</i> .	
3. The <i>Eyes</i> become <i>dim</i> .	
4. The <i>Surface</i> flaccid, cold, and pale; and,	
5. The Person <i>sinks down</i> inanimate, - ib.	
{ This <i>Train of Symptoms</i> may admit of some Elucidation from the following <i>curious</i> <i>Fact</i> , - - - - -	621
{ Mr. HUNTER took Blood from a Lady which was of a <i>dark Colour</i> , - - - - -	ib.
{ The Lady <i>fainted</i> , and as she continued in that State the <i>Colour</i> of the <i>Blood</i> that came from the <i>Vein</i> was of a <i>bright Scarlet</i> , ib.	
{ Mr. HEWSON observes, that often in Bleed- ing the <i>first</i> Cup shall have <i>florid Blood</i> , the second <i>black Blood</i> , and the third <i>florid</i> or <i>crimson</i> again, - - - - -	ib.
{ He observes also that in Animals who are bled to Death, the Blood becomes <i>brighter</i> in proportion as they become <i>faint</i> , and it coagulates the more, - - - - -	622



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{ In these Instances the *arterial Blood* did not impart to the *muscular Fibre* its OXYGEN, hence its *florid Colour*, and the *Train of Symptoms* above enumerated, - - - - ib.

{ During *this Torpor* the IRRITABLE PRINCIPE accumulates in the *Blood*, and the Patient, if left alone, will soon recover, - - - - ib.

{ To accelerate which, however, the Patient ought to be exposed,  
1st. To *fresh Air*, or what would be still better,  
2d. To *vital Air*,  
3d. The Face should be sprinkled with *Vinegar*,  
4th. And the Hands may be rubbed with *cold Water*, - - - - 623

{ A Fact to prove that IRRITABILITY is accumulated during the *Operation of Terror*, - ib.

## SECT. LII. OF ASPHYXIA FROM OPIUM.

{ NEW DISCOVERIES are refuted,  
1st. From PREJUDICE, which actuates *little Minds*,  
2d. From SELF-LOVE inherent in *great Minds*, - 625

{ The Attention of Physicians has deservedly been turned towards *Opium* for a Series of Years, - - - - - ib.

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{ Nevertheless its <i>Mode of Action</i> has been violently <i>disputed</i> , - - - - -	625
{ Some deem it,	
1. Altogether <i>sedative</i> ,	
2. Others <i>stimulant</i> , and	
3. Others <i>both stimulant and sedative</i> , -	ib.
{ This <i>Controversy</i> appears to have its Rise from the <i>different Effects</i> which takes place according as it is <i>administered</i> , - - - -	ib.
{ A COMPARISON betwixt the Effects of <i>Opium</i> and <i>Wine</i> , - - - - -	626
1. A <i>small Dose</i> of either is STIMULANT only,	
2. A <i>larger Dose</i> is both STIMULANT and SEDATIVE, and	
3. A <i>more considerable Dose</i> is almost immediately SEDATIVE.	
{ These <i>Observations</i> are proved by an Experiment on a Frog, - - - - -	627
{ The next Enquiry is by <i>what Channel</i> does OPIUM act ? - - - - -	ib.
{ Seeing the <i>Errors</i> that <i>great Men</i> have been in we ought not to rely too much on <i>Authority</i> , - - - - -	628

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{ OPIUM acts in *whatever Way* it be introduced  
into the System, - - - - - 628

{ A Conjecture that many *Poisons* act by de-  
stroying the *relative Attractions*, thereby oc-  
casioning NEW COMBINATIONS, - - - 629

{ Experiments to prove that the *Poison* of the VIPER does  
not act through the *Medium* of the *Nerves*, - - - 629

1. The *Nerves* going to the Leg of a Rabbit being divided, it became *paralytic* and *insensible*; ne-  
vertheless it *communicated* the Effects of the Poi-  
son of the Viper.
2. When the *Nerves only* were covered with the  
*Venom*, it produced none of the *Symptoms* of the  
*Disease*.
3. On the contrary, when the *Veins* and *Arteries*  
going to the Leg were *intercepted*, the *Insertion*  
of *Venom* produced no *Disease*.

{ Experiments to prove that OPIUM does not act  
through the *Medium* of the *Nerves*, - - - 630

{ The *crural Nerves* were laid bare in 300  
Frogs, - - - - - ib.

{ It was so contrived, that *these Nerves* could  
be covered with OPIUM without this Poison  
touching any other Part, - - - - - 631

{ By *this Expedient* COMPARATIVE TRIALS were  
made, - - - - - ib.

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{ At the End of *ten, fifteen, and twenty Minutes*,  
BOTH NERVES had *equal Sensibility*; that is,  
*the Nerves* covered with *Opium*, and *those*  
to which *no such Application* was made, - 631

{ The *Nerves* are therefore *not affected* by  
OPIUM, - - - - - 632

{ Sir JOHN PRINGLE'S *Conviction* from *these Ex-*  
*periments*, - - - - - ib.

{ A Solution of OPIUM was *injected* into the  
*Blood-vessels* of an animal, when, on the  
contrary, it died *immediately*, - - - - 633

{ This *instantaneous Effect* cannot arise from  
NERVES, since the *Arteries* are *not furnished*  
with *Nerves*, - - - - - 634

DR. MONRO'S CELEBRATED EXPERIMENT, - ib.

{ He injected OPIUM under the Skin of the Leg  
of a Frog, and its Effects *extended* to the  
*most distant Parts of the Body*, - - - - ib.

{ But if he *intercepted* the *Veins* and *Arteries*  
going to the Leg, it then did *not extend* to  
the other Parts of the Body, - - - - ib.

{ OPIUM acts equally on the *vegetable Tribe*, as  
is proved by Drs. GIRTANNER, GAHAGEN,  
INGENHOUSZ, THORNTON, &c. - - - 635

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{ It <i>acts</i> also on <i>Parts separated</i> from the BRAIN, - - - - -	635
{ Thus the <i>Pulsation</i> of a HEART taken from the Body are immediately stopt by only a few Drops of <i>Laudanum</i> , - - - - -	ib.
{ The same is observed of the <i>Intestines</i> , - -	ib.
{ OPIUM acts therefore most probably through the medium of the <i>Blood</i> , - - - - -	636
{ Does not the OXYGEN of the Blood enter into some <i>new Combination</i> , the <i>Law of Affinity</i> through the Influence of the OPIUM being changed? - - - - -	ib.
{ Is not this proved from the <i>Symptoms</i> occa- sioned by OPIUM, and the <i>State</i> of the Body after <i>Death</i> ? - - - - -	ib.
{ <i>This Opinion</i> first suggested by Dr. BEDDOES, an enlightened and reformed System of Physic will soon, perhaps, satisfactorily elucidate, - - - - -	ib.
{ <i>Two very striking Cases</i> to illustrate THIS SUPPOSITION, - - - - -	637, 638

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{ They prove that *this Poison* does not *act* on the NERVES, but on the IRRITABLE PRINCIPLE of the *moving Fibres*, through the *Medium* of the *Blood*, - - - - - 641

{ FONTANA discovered, after numerous Trials, that the LUNAR CAUSTIC (*Silver* combined with *Oxygen*) was an *Antidote* to *this Poison*, - - - - - ib.

{ HIS DECISIVE EXPERIMENTS on this Head,  
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3d. Where the Animals *swallowed* a *solution* of the LUNAR CAUSTIC, - 645

{ His Observations on EMETICS, - - - - - ib.

{ A Query, whether any other Emetic than a *metallic Oxyd* would have had any beneficial Effect? - - - - - 646

{ Of the Poison of the TICUNAS, - - - - - 646

{ *This Poison* being dissolved in the *three Mineral Acids*, the NITROUS, VITRIOLIC, and MARINE ACIDS, as also in the VEGETABLE ACID, was found to have *lost* its *deadly Power*, - - - - - ib.

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{ This could not arise, says FONTANA, from its <i>Causticity</i> , as the CAUSTIC ALKALI has no such Property, - - - - -	647
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{ When the Patient will not <i>submit</i> to <i>this</i> <i>Operation</i> what <i>next</i> should be pursued, -	ib.
{ Dr. THORNTON'S <i>practice</i> in THIS INSTANCE,	ib.

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{ Dr. RICHARD LOWER was the first who invented the Method of TRANSFUSING BLOOD from one Animal to another, - - - -	ib.
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{ 1st. The Trials made by the ROYAL SOCIETY on <i>Animals</i> , - - - -	654
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{ BARON DE HALLER observes, that by the Transfusion of Blood the whole Machine of the Animal is endowed with <i>remarkable Vivacity</i> , - - - -	ib.
{ Some <i>unfortunate Trials</i> were at length made, ib.	
{ 1st. On a <i>consumptive Patient</i> , and	
{ 2d. On a Man of the first Eminence labouring under an <i>Inflammation of the Bowels.</i>	
{ It was prohibited by the KING's MANDATE in <i>France</i> , and by the POPE's MANDATE at <i>Rome</i> , - - - -	656

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{ Thus was defeated a *noble Essay*, begun with  
*Prudence* in ENGLAND, but *imprudently*  
*pursued* in FRANCE and SWEDEN, which,  
 had the *first Trials* on the *human Species*  
 been conducted with *care* and *caution*,  
 might in *Time* have produced most USEFUL  
 and SURPRISING EFFECTS, - - - - - 656

{ It is remarkable that the *first Trials* of the VITAL  
 AIR were made in *Consumption* in FRANCE. It  
 gave *temporary Benefit*, and spread, as CHAPTAL says,  
*Flowers over the Borders of the Tomb*, but *hastening* on  
 the *mournful Catastrophe* it was soon abandoned, and had  
 not Dr. BEDDOES and his *Coadjutors*, Dr. DARWIN,  
 Dr. EWART, Dr. THORNTON, &c. been conducted  
 by a *rational Theory*, which they have *established* by  
*practice*, the AERIAL REMEDIES had *probably* met  
 with the *same Fate* as TRANSFUSION, - - - - - ib.

{ The Introduction of VITAL AIR into the  
 Practice of Physic has thrown great Light  
 on the Operation of TRANSFUSION, - - - - - ib.

{ In the Operation of TRANSFUSION care must  
 be taken not to throw in *too great a Quan-*  
*tity of Blood*, - - - - - - - - - - - ib.

{ A FACT to *illustrate this*, - - - - - - - - - - - ib.



MATTER PRELIMINARY TO THE EXPLANATION OF  
THE SECOND LAW OF THE NERVOUS AND FIBROUS  
SYSTEMS.

SECT. XXX.

OF THE IRRITABLE PRINCIPLE.

WE know not, says Dr. BROWN, what the IRRITABLE PRINCIPLE really is\*. We may, however, define it to be “*a property inherent in moving fibres at the commencement of their animate state, which enables them to react upon the application of stimuli; that its powers are different in different animals; and vary at different times even in the same animal.*” In like manner was Sir ISAAC NEWTON at a loss to explain what gravity was: for philosophy is aptly represented by a temple, whose front alone is visible, but whose basis is involved in impenetrable clouds and darkness. Even the Indian philosopher, who taught that the earth was supported by an elephant, and that elephant by a tortoise, was obliged to stop somewhere.

\* This difficult problem may perhaps admit of a solution, and if the IRRITABLE PRINCIPLE be not the OXYGEN in the system, its dependence or relation to it can be, however, clearly ascertained, and the reader will find this important subject particularly treated on in this volume, Sect. XXXII. *Of OXYGEN as related to IRRITABILITY*; and Sect. XXXVI. *Of OXYGEN as the Principle of IRRITABILITY*.

## S E C T. XXXI.

## OF THE SENTIENT PRINCIPLE.

THE man of deep science comprehends no more the nature of *this great prerogative* of organized animated beings, endowed with brain and nerves, than the poorest peasant; or than he understands the secret influence of the magnet, or the irritability of the contractile fibre. NATURE has hid this attribute of her power from the vain search of man. Hereby SHE hath removed the line, that separates the philosopher and the clown. But the philosopher, disappointed in this deep research, still perseveres in the pursuit of useful knowledge, and with unwearied ardour he contemplates the *different structures*, wherein the *same offices* are designed by an OMNIPOTENT POWER, and he discovers, “*that in animals the differences in structure affixed to the organs of sensation constitute the main differences in perception;*” for where the sense of smell, &c. as in the dog, is more acute than in us, the figure of that organ is more complex, and disclosing a greater degree of art: and “*that the powers of the*

*nerves depend on the structure of the parts to which they are connected.*" Thus the nerve, which goes to the tongue, gives the sensation of taste, and supplies also the muscles moving that organ. The par vagum, which gives sensation to the stomach and lungs, likewise affords the power of motion to the muscles of the throat. And thus the sensation of touch may arise from the same nerves which pervade the muscular fibres.

This doctrine is beautifully displayed by the invaluable museum prepared by that first of anatomists and naturalists, the late JOHN HUNTER. Let it not, however, lead the enemy to science (for some such characters there are) to object to him on that account Materialism and the Disbelief of the doctrine of a future state.

"Thou fool," says the philosopher and apostle, "that seed which thou sowest is not quickened except it die. And that which thou sowest, is not *that body* that shall be: but GOD *giveth it a body* as it hath pleased HIM; and to every seed its own body.—So also the RESURRECTION of the dead. The body is sown (in the earth) in *dishonour*; it is raised in *glory*; it is sown in *weakness*, it is raised in *strength*. It is sown a *natural body*, it is raised a *spiritual*. Behold, I shew you a mystery. We shall not all sleep, but we shall all be CHANGED. In a moment, in the twinkling



twinkling of an eye, at the last trump ; for the trumpet shall sound, and the dead shall be raised *incorruptible*, and we shall be CHANGED. For this *corruptible* must put on *incorruption*, and this *mortal* must put on *immortality*."

Man, therefore, is not what he will hereafter be. What we discover of him here below, is only the *gross foldage* under which he crawls upon the earth, and which he must shortly *cast off*.

Could not the *omnipotent* AUTHOR OF NATURE, who pre-ordained all beings from the beginning, who originally enclosed the *gaudy* and *winged butterfly* in the *chrysalis*, the *plant* in the *seed*, comprise the *spiritual body* in the *animal* ?

The *animal body* has no other relation than to this earth. The *spiritual body* will have *enjoyments* which ear hath not heard, nor hath it entered into the heart of man to conceive ; *new senses* will disclose themselves, and, by multiplying in an almost infinite degree his perceptions, his sphere will be aggrandized, and he will be equal to superior intelligences.

REVELATION informs us *it will be so* ; and the parable of the *seed* is the most expressive and philosophic emblem of this wonderful pre-ordination.

The *senses*, as they will be brought into subjection to  
the



the soul, will no longer rule over her. Separated from *flesh* and *blood*, there will remain in her none of those earthly affections which resulted from them. Transported into the regions of light, the human understanding will present no ideas to the will but those of the highest good. It will then have no other than lawful desires, and GOD will be their constant and ultimate end. It will love HIM from gratitude; will fear HIM from a principle of love; and will adore HIM as the SUPREME AMIABLE BEING, and as the ETERNAL SOURCE of life, perfection, and happiness.

*Christians*, who believe this doctrine of life, can ye have any dread of *death*? Your immortal spirits continually cleave to matter, and they are indissoluble; being henceforth united to an *unperishable* and *differently organized body*, she looks upon *death* as a happy *transformation*, which, by disengaging the seed from its foldage, will give a new being to the plant. “O *death*, where is then thy sting! O *grave*, where is thy victory!”

## SECT. XXXII.

## OF OXYGEN AS RELATED TO IRRITABILITY.

THOUGH impenetrable clouds and darkness conceal the irritable and sentient principles from our view, nevertheless some philosophers of the present day have gone so far, as to discover the condition of its existence.

They observe first, “ *that every thing that increases the quantity of OXYGEN in organized bodies, increases at the same time their irritability.*”

A considerable quantity of very pure *oxygen air* was injected into the jugular vein of a dog. Upon opening the thorax and the pericardium of the animal, the heart was found *more irritable* than ordinary, and its alternate contractions and dilatations continued upwards of an hour.

The *right auricle* of the heart was vermilion, and it contained, as well as the *right ventricle*, a great quantity of blood of a bright vermilion colour. The blood contained in the *left auricle*, in the *left ventricle*, the *aorta*, and the *arteries*, was of a bright rose colour, and mixed with bubbles of air.

All the muscles were *more irritable* than ordinary.

After the blood contained in the heart and arteries was discharged, the *irritability* of the heart and muscles was sensibly diminished.

This experiment proves, most decisively, that the *vermilion colour* which the blood assumes in passing through the lungs is not owing to *the loss* of CHARCOAL and HYDROGEN; but that it proceeds from *the combination* of the blood with the OXYGEN AIR.

In the experiment I have just now described, the livid colour of the venous blood in the *right auricle* and *ventricle* of the heart was changed to that of vermilion. Nevertheless it could not have *lost* any CARBON or HYDROGEN: it therefore only *acquired* OXYGEN or VITAL GAS.

This experiment is also a direct proof that OXYGEN favours *the principle of irritability*; for by *surcharging* the blood with *oxygen*, by *hyper-oxygenating* it, if I may use the expression, the *irritability* of the contractile fibre was, as we have seen, considerably *increased*.

The *irritability* also of persons made to breathe OXYGEN AIR is wonderfully increased, as is shewn by an universal increase of energy in the system. But what shews more clearly than all, says GIRTANNER, that

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the *irritability* is always *in proportion* to the quantity of OXYGEN in the system, are the phænomena attending the action of *mercury* and *mercurial oxyds* upon animals. As is this one of the most striking proofs of this theory, and as many persons, and amongst the rest, philosophers of the first rank, such as Dr. CRAWFORD, have been struck with the novelty and simplicity of my mode of explaining these phænomena, I cannot forbear, says he, entering into some detail upon this subject.

It is a well known fact among physicians, that *mercury*, in its *metallic state*, has *no effect* upon the human body. I have known many people, who for many years have taken a daily portion of quicksilver, to the amount of one or two ounces, but who never perceived any effect whatever from this singular and ridiculous custom. It is proved also by the experiments of Dr. SAUNDERS, that the effects of mercurial ointment are owing only to the small quantity of mercury that has been *oxydated* during a long trituration. It is necessary, therefore, that mercury should be oxydated, to have any effect on the human body. Besides, it is well known that in persons who have rubbed themselves with mercurial ointment, or who have taken the oxyd of mercury,

cury, the *mercury*, after having *produced* its usual effects, has passed through the skin in a *metallic form*, and has amalgamated itself with watches, and the gold in the pocket, &c. The oxyd of mercury, in passing through the human body, parts with its OXYGEN, and it is this *oxygen* alone, which remains combined with the system, that *the effect* produced by *oxydated mercury* is owing. Thus *arsenic*, under its metallic form, has no effect upon animals; but the *white oxyd* of this metal is one of the most terrible poisons; for it *hyper-oxygenates* the organized fibre with which it comes into contact, and reassumes its metallic form.

The cause of the beneficial effects of *steel* on the animal œconomy has not been hitherto sufficiently scrutinized. According to Monsr. CHAPTAL, the red particles of blood almost wholly consist of *iron*. And it is well known that the blood acquires its florid colour from its exposure to the air in the vesicles of the lungs, from whence nothing but VITAL AIR is absorbed. It seems therefore probable, that the red particles of blood consist chiefly of particles of iron, calcined by the OXYGEN, or VITAL AIR, and reduced to the state of a red oxyd of iron. Hence it appears, that *chalybeates* will not only

Vol. I. increase

increase the quantity of red particles in the blood on which the stimulant and tonic powers of that fluid, most probably in a great measure depend, but will enable it to decompose a larger quantity of air which is received in the lungs by respiration, and thus occasion a greater evolution of heat, and will produce the same effect upon the system, as if a much purer atmosphere had been breathed for some time\*.

By various experiments of Dr. HALE's, compared with those of Dr. INGENHOUSZ, it is evident, says the celebrated author of *the Guide to Health*, that vegetables in summer, while they enjoy the sun, are incessantly decomposing water, and emitting from their leaves their *oxygen* combined with *caloric* in the form of VITAL AIR. And it is clear, that as long as water is supplied abundantly, they not only preserve their vigour, even at mid-day with the most fervent heat, as in the south of Spain, but make a rapid progress in their growth, and emit a proportionable quantity of *vital air*. May we not infer from thence, *that their irritability depends on OXYGEN, and their vital energy on a plentiful supply of this reviving ele-*

\* Dr. GARNETT.



ment, whilst the *hydrogen* of the water not only supplies the combustible part of vegetables, but, by depositing its caloric, maintains the vital heat.

Should Drs. GAHAGEN and THORNTON pursue the experiments they have so successfully begun, or should other philosophers, with the same ardour of enquiry, take up this subject, we shall then be able, says the Rev. Mr. TOWNSEND, to ascertain a fact, asserted by the former, that the plants called sensitive may be deprived of their sensibility by opium, alkohol, and oil; whilst vinegar, and the oxyds of arsenic or mercury, communicates even irritability to plants as did not possess it before.

Were these facts well ascertained, it would throw great light upon the operation of these medicines in the human frame, and contribute to establish the system; now received by many, respecting *irritability* as induced by OXYGEN.

2. "*Whatever diminishes the quantity of OXYGEN in organized bodies, diminishes at the same time their irritability.*"

A small quantity of *azotic air* was injected into the jugular vein of a dog. The animal died in twenty seconds. Upon opening the thorax, the pericardium, and the heart,—*the right auricle and ventricle* were filled with black blood. The *left ventricle* was of its ordinary colour.



colour. The heart, and almost all the muscles, had *lost* their *irritability* almost entirely; they contracted but weakly upon the application of the strongest stimuli, such as sulphuric æther, and the electric spark.

When consumptive patients under the judicious management of Dr. BEDDOES, at the Hot-Wells, Bristol, and Dr. THORNTON in London, breathe *azotic* or *hydrogen air*, blended with a small portion of *vital air*, the circulation, irritability, sensibility, and appetite is diminished, and the hectic fever is abated\*.

There was long since a dispute between Dr. WHYTT and Baron de HALLER respecting *irritability*, and that dispute is not yet completely settled. The *former* attributed this power wholly to the *nerves*; the *latter* to the *muscular fibre*, independent of the nerves.

But were we permitted to reason from analogy, we might suspect, if not conclude, that since *plants*, by irritability alone, without brain or nerves, exercise the vital functions; these likewise may in animals depend on the irritability of the muscular fibre, whilst sensation,

\* Vide Observations on the *Medicinal Use* of the *Facitious Airs*, by Dr. BEDDOES; also the Letters of Dr. THORNTON, Dr. EWART, Dr. PARRT, &c. to the same.

thought,

thought, and voluntary motion, result undoubtedly from the presence of a brain.

The womb, in the time of pregnancy, increases in substance and size probably fifty times beyond what it naturally is, and this increase is made up of living animal matter, which is capable of action within itself. I think we may suppose its action more than double; for the action of every individual part of this viscus, at this period, is much increased, even beyond its increase of size; and yet we find that *the nerves* of this part *are not* in *the smallest degree increased*. This shews that the nerves and brain have nothing to do with the actions of a part: while the vessels, whose uses are evident, increase in proportion to the increased size: if the same had taken place with the nerves, we should have reasoned from analogy!

If nerves, either of themselves, or from their connection with the brain, gave vitality to our solids, how should a solid continue irritable, after a nerve is destroyed, or paralytic? for the part continues to be nourished, although not to the full health of voluntary action; and this nourishment is the *blood*, for deprive it of the blood, and it mortifies.

This

This opinion is countenanced by the experiments of Baron de HALLER ; some of which are recorded in one of the early volumes of the Philosophical Transactions, for it appears that a *paralysis* of the posterior extremities of animals was induced by tying their aorta.

The learned Dr. MONRO, who was not much inclined to give up the pre-eminence of the brain and nervous system to the vascular, after many experiments was obliged to conclude, “ *that concomitant arteries, somehow or other, tune the nerves, so as to fit them to convey impressions.*”

In order to decide, says the ingenious Dr. FOWLER, whether a greater detriment to that condition of a limb, upon which contraction depends, is induced by interrupting *its circulation*, or by intercepting *its communication with the brain*, I resolved upon trying the powers of the nervous electricity as discovered by GALVANI.

Having tied the *crural artery* on one side, and divided the *sciatic nerve* on the other, on three full grown frogs, I cut off their heads with a pair of scissars, to preserve the circulation of the blood as entire as possible, and at the same time to prevent the continuance of pain, which might exhaust the power of the body, and defeat the experiment.

When

When these frogs were laid upon a surface of zinc, and excited by means of a rod of silver, the contractions were found *extremely feeble* in the legs whose *artery* had been tied, and ceased altogether in about *twenty-two* hours after their death. But in the legs, whose *nerve* had been divided, they appeared *very vigorous*, and continued excitable upwards of *two* days after they had ceased to be so in the other.

Having thus found, that a diminution of the circulation of a part, was accompanied with a proportionable diminution of the respective powers of nerves and muscles in that part, I next proceeded to examine if an *increased circulation* would be attended with a proportionable increase of these powers; and that this is actually the case, the facts I am about to relate will prove.

I have before shewn, that if a living and entire frog be set upon a plate of zinc, contractions can very seldom be produced in any part of its body by passing a rod of silver over it, so that the silver, the frog, and the zinc, may be all in contact with each other. But I have found, in upwards of twenty experiments, that when *inflammation* had been excited in one of the hind legs of a frog, by irritating it with a brush, contractions uniformly took place in that leg when the metals were

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applied

applied to it, although none had been produced in it before it was inflamed, nor could still be produced in the other leg which remained in its natural state.

Having previously, continues Dr. FOWLER, excited *inflammation*, by means of a brush, in the foot and leg of a healthy and large frog, I cut off its head. The contractions excited by the different metals in the inflamed leg were in vigorous and instantaneous jerks; those in the sound leg more languid, and difficultly excited. Spontaneous motions continued at this time nearly the same in both. Even till the end of the second day, after the frog's head had been taken off, the contractions excited in the inflamed leg continued uniformly, and beyond all comparison more vigorous than what I could by any means excite in the sound leg. It then became very stiff.

Dr. FOWLER, from these experiments, has judiciously concluded, that the *sanguiferous system* contributes more immediately than the *nervous* to the support of *that condition* of muscles and of nerves, on which *depend all the phænomena of contraction in the animated fibre*.

This subject, it must be confessed, is after all exceedingly abstruse, and the ideas of the best physiologists are not so clear and distinct, so complete and comprehensive,



as we could wish: but, as Dr. BEDDOES has judiciously observed,

WE SHOULD SET A PROPER VALUE ON OUR PRESENT KNOWLEDGE, ALTHOUGH IT BE IMPERFECT, AND RESTRAIN THOSE RUDE HANDS, THAT ARE EVER READY TO PLUCK UP THE TENDER PLANTS OF SCIENCE, BECAUSE THEY DO NOT BEAR RIPE FRUIT AT A SEASON, WHEN THEY CAN ONLY BE PUTTING FORTH THEIR BLOSSOMS.

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*Of the importance of the IRRITABLE PRINCIPLE, derived probably from oxygenated blood, we shall soon learn, if we consider the vast expence of it continually going on in the system. First, the IRRITABLE PRINCIPLE is expended in giving perpetual and strong motion to the heart, which overcomes the elasticity and vis inertiae of the whole arterial system:—next the expence of the IRRITABLE PRINCIPLE in moving, with great force and velocity, the innumerable trunks and ramifications of the arterial system: the expence of the IRRITABLE PRINCIPLE in circulating the whole mass of blood through the long and intricate contortions of the very fine vessels, which compose the glands and capillaries;—then the expence of the IRRITABLE PRINCIPLE in the exertions of the absorbent extremities of all the*

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*laſicals,*

*laëteals, and of all the lymphatics, which open their mouths on the external surface of the skin, and on the internal surfaces of every cell or interstice of the body ;—then the expense of the IRRITABLE PRINCIPLE in the venous absorption, by which the blood is received from the capillary vessels, or glands, where the arterial power ceases, and is drank up, returned to the heart ;—next the expense of the IRRITABLE PRINCIPLE used in the muscles of respiration in their office of perpetually occasioning the expansion of the bronchia, or air-vessels, of the lungs ;—and lastly, in the unceasing peristaltic motions of the stomach and whole system of intestines, and in all the secretions of bile, gastric juice, mucus, perspirable matter, and the other excretions from the system.*

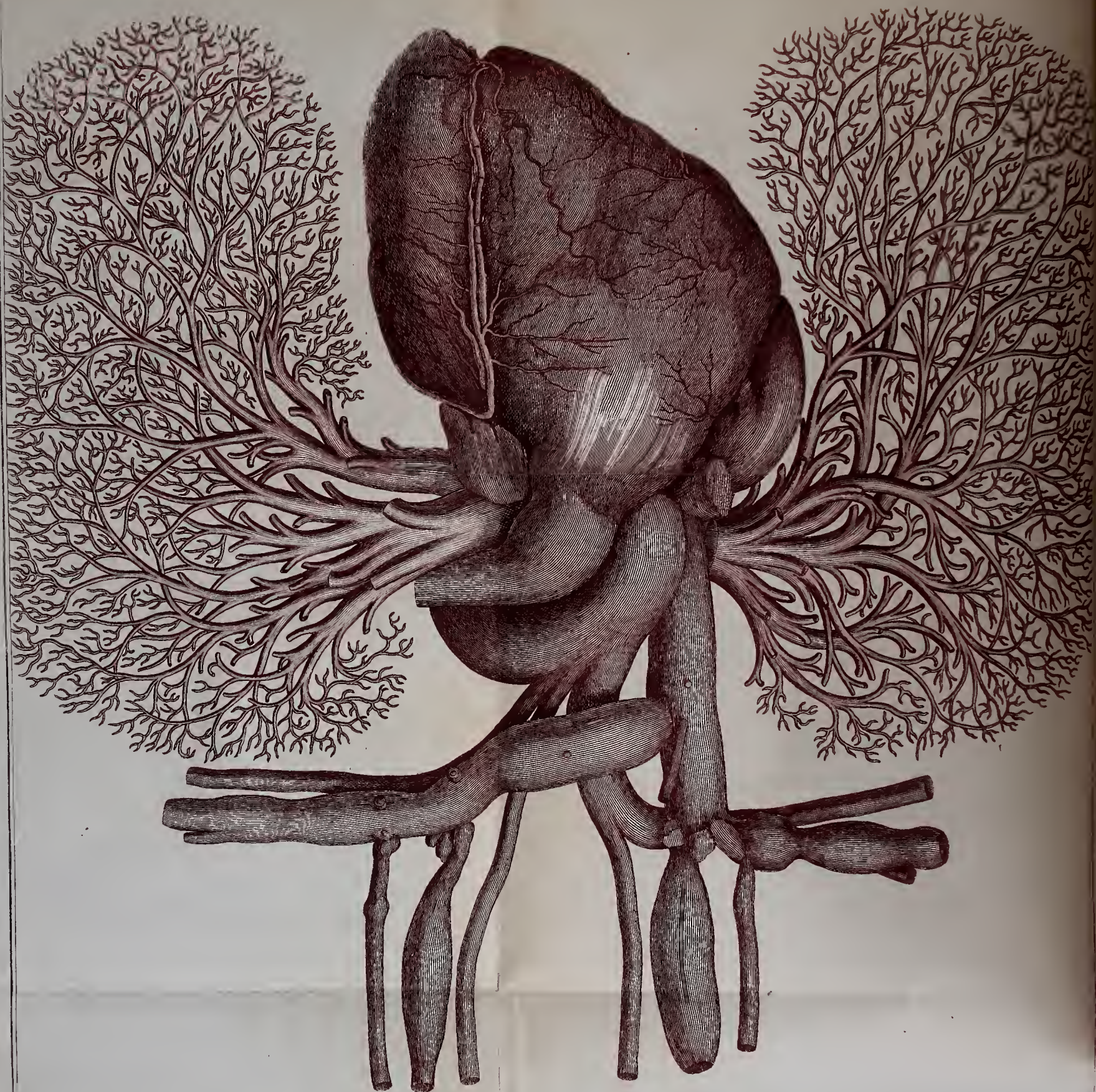
If we consider the ceaseless expense of irritable principle thus perpetually employed, it will appear to be much greater in one day, than all the voluntary exertions of our muscles and organs of sense in a week. Hence when the vital organs are too forcibly put into action by any stimulus, without a proportionally increased production of the irritable principle in the system, it is evident that a great deficiency of action soon ensues, or A STATE OF EXHAUSTION \*. But of this we are to consider more at large in the following sections.

\* DR. DARWIN.











## S E C T. XXXIII.

## OF THE VITALITY OF THE BLOOD.

THE *vitality of the blood* was a doctrine first broached by the immortal HARVEY. This, like the *circulation*, was paid however little attention to, until it was revived by the illustrious JOHN HUNTER.

This idea led to a very important discovery in natural philosophy, namely, that it is to the atmosphere, and to that particular part of it which goes by the name of *vital*, or *oxygen air*, that we are indebted for that vitality which is communicated to the blood, and which animates our bodies, and is the immediate bond of union betwixt our immaterial soul and this visible world.

The *blood*, says the immortal HUNTER, has as much the *materia vitæ* in it, as the *solids*, which keeps up the harmony that exists between them. And as every part endued with this vital principle has a sympathetic affection from apposition of parts, as to affect each other; so the *blood*, and the *body*, are capable of affecting, and being affected by each other. The *blood* being evidently composed of the same constituent principles as the *body*,  
and

and being endowed with the same living powers as the contractile living fibre; and as having evidently no communication with the brain, it affords one of the strongest proofs of the vital principle in both solids and fluids, being independent of *the nerves*; and is similar in this respect to those inferior order of animals and plants that have *no nerves*, but where the living principle is diffused throughout the whole.

*Respirable air*, says this eminent anatomist, has the property of heightening the red colour of the blood to a scarlet; and this, with its consequent *heat*, is supposed to be the chief or only use of respiration:—but if we suppose the change of colour in the red globules to be all that respiration is to perform, we shall make the *red globules* the most essential part of the blood, whereas that may be said to be the least. It is most probable, that *the effect* of *air* on *the blood* is greatest on the *coagulable lymph*; and this conjecture is rendered more likely, when we consider, that in cold animals\* which have no red globules, *respiration*.

\* Having at hand some water from the hot-well at Bristol, which I had found to contain air in a state of great purity, I completely filled, says Dr. PRIESTLEY, a large phial of it, and I put into it a few very small fish, which I had provided for the purpose of these experiments. They were minnows,

*spiration* is as essential to their existence as in any other.

*Coagulation*, Mr. Hunter conceives to be an operation of life similar to *muscular contraction*. The *coagulability* of animated fluids will be found subject to the *same laws* as the *irritability* of the fibre. This is a *new discovery*; and it forms the basis of *many important truths*.

A piece, *three inches* in length, being cut out from a straight muscle in an ox's neck, immediately after his being knocked down, was placed in a freezing mixture for fourteen minutes. At the end of this time it was only *two inches* in length. Upon being thawed gradu-

ally, and other small fish about two inches in length. In this water they were confined without any access of common air till they died.

After this I took equal quantities of the water in which the fish had died, and of that out of which it had been taken, where they were confined in; and I expelled from both all the air which they would yield. That from the water in which no fish had been put, exceeded in quantity that from the water in which they had been confined, in the proportion of 3 to 2; and examining the quality of both these quantities of air, by the test of nitrous air, the former exceeded the latter in a still greater proportion.

The air from the water in which no fish had been confined was at the standard of common air, but that which had been contaminated by the respiration, as I may say, of the fish, was something *worse* than air in which a candle just goes out.

From this experiment it may be concluded with certainty, that air contained in water, in an unelastic state, is as necessary to the life of fish, as air in an elastic state is to that of land animals.

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ally, in about six hours after thawing, it contracted so as to measure only *one* inch. Here then were the pieces of muscles frozen, so as to prevent all power of contraction in their fibres, without destroying their life; when thawed, they shewed the *same irritability*, which they had before; this is exactly similar to the freezing of blood too fast for its coagulation; which, when thawed, does *afterwards* coagulate, as it depends in each on the irritability of the part not being destroyed.

As the heat of 120 degrees excites the blood to coagulate, he wished to try how far muscular contraction was similar in this respect. He took a piece of a muscle from a sheep newly killed, and put it into water heated to 120 degrees, when it contracted directly, so as to become hard and stiff.

Animals killed by lightning, and also by electricity; have not their muscles contracted: this arises from the irritable principle being instantaneously destroyed in the muscles, which therefore cannot be affected by any stimulus, not even the pain of death. In such cases the blood does not coagulate. Blows on the stomach kill immediately; and the muscles do not contract, nor does the blood coagulate. Death from sudden gusts of passion

is of this kind ; and in all these cases the body soon putrefies after death. Animals that are run very hard, and killed in such a state, or, which produces a still greater effect, are run to death, have neither their muscles contracted, nor their blood coagulated: and in both cases the effect must be in exact proportion to the cause.

In the West India islands they kill their poultry with vegetable poisons, in order to render them tender without keeping. For the same reason, the expedient was devised to satisfy a shameful gluttony, namely, the flogging of animals to death.

The general debility, and laxity of the muscles, brought after repeated venesection, and the great prostration of strength, and even death, produced by hæmorrhage, when the evacuation of the blood is considerable and suddenly made, must be considered as a strong proof, added to the thin state of the blood, of the living principle being inherent in the blood, and of its having a similar nature as the muscular fibres.

On the contrary, in diseases where the action of the heart was going on very strong, the muscles after death contract strongly, and the blood strongly coagulates. This *coincidence* of *coagulability* in the *fluids*, and *irritability* in the *solids*, that is, both *shortening their*

3 A *dimensions,*



*dimensions, and obedient to the same laws*, clearly proves that they both depend on the *same cause*. The living principle, therefore, in the *blood*, which I have endeavoured to shew to be similar to the living principle in the *solids*, owes its existence to the same matter which belongs to the other, which is the *materia vitæ diffusa*, of which every part of an animal has its proportion: it is as it were diffused through the whole *solids* and *fluids*, making a necessary constituent part of them, and forming with them a perfect whole; giving to both the power or susceptibility of impression; and, from their construction, giving them consequent reciprocal action.

## SECT. XXXIV.

## OF OXYGEN AS RELATED TO SENSIBILITY.

THERE is no doubt but that *sensibility* resides in the nerves, as *irritability* does in the contractile fibre; but since *both* sensibility and irritability are *suspended* by submersion, and only *restored* by the blood receiving the oxygen principle from a pure respirable air, may we not from thence infer that they depend both for their powers of action on the *same cause*?

We observe that where it is intended that nerves shall convey impressions with great accuracy, as in all the senses, the distribution of blood-vessels is more profuse than in almost any other equal part. When the white of the eye gets inflamed and suffused with arterial blood, the feeling of that part is rendered uncommonly acute. Even insensible parts, as tendons and bones, from disease become extremely sensible. In short, wherever there is an increase of vascular action in any part of the body, it is always attended with a proportional increase of *sensibility*.

This opinion, which stands opposed to the doctrine of

tenſion, is greatly ſtrengthened by an experiment related by Dr. BEDDOES. He made a bliſter on his hand, and cutting it in *fixed air*, which holds too firmly its *oxygen* to diſengage it, he experienced no ſenſation of pain; he then expoſed his hand to *common air*, when he immediately felt pain, and afterwards to *oxygen air*, when the pain became intense; then removing it to the *fixed air*, he felt an almoſt inſtantaneous relief.

It has been obſerved, moreover, that the *animation* of thoſe who inhale a *ſuper-oxygenated atmosphere* is greatly increaſed, whereas in diſeaſes where there is a defect of this principle in the conſtitution there is the greateſt *ennuie*.

The power of *wine* in raiſing the ſpirits, is ſuppoſed to ariſe from the ſame cauſe, viz. by increaſing the attraction of the blood for the *vital* or *oxygenous portion* of the air, as was before obſerved, when relating the experience of the celebrated diver Mr. Spalding\*.

\* Vide page 89.

## SECT. XXXV.

## LAW II.

A TOO GREAT EXCITEMENT OF ANY ORGAN EXHAUSTS  
THE EXCITABILITY OF THE CONTRACTILE FIBRE.

1. *Of exhausted Irritability.*

EVERY stimulus which affects *one* of the fibres affects the *others* at the same time, and in like manner. Hence the *sympathy* of different and separate parts, and those surprising phænomena which hitherto have been explained by the harmony of the nerves. These *sympathetic phænomena* are observable throughout all organized nature. Whatever part of the *polypus* be touched, the *whole* will contract, and its arms will contract themselves by sympathy. If a *worm* be touched with the point of a pin, without wounding it, the *whole worm* will be seen to contract itself; which is a certain proof that the different parts are affected by sympathy. Hence the *irritable fibres*, which are combined together in every individual, whether animal or vegetable, form A SYSTEM OF FIBRES, in which the *integral parts* act continually

tinually upon *the whole*, while *the whole* re-acts upon *the parts*, so that every stimulus which acts upon any fibre in the system, will deprive that part of its irritability; but this loss will be soon repaired by the system, and every fibre will furnish in proportion some share of its own irritability to supply the loss in any one fibre. Thus it is that *a too powerful stimulus* acting upon *any one part* of the system, such as the abuse of spirituous liquors, and tonic medicines, exhausts in the end the *whole system*, and produces death: For the same reason, a very powerful stimulus applied to one part of the system, such as the poison of a rattlesnake, will, in an instant, exhaust all the irritability, render the blood fluid, and destroy the animal.

From what has been said, it will appear, that the IRRITABILITY of the system is never in a permanent condition, but incessantly ebbing and flowing like the tide; constantly in motion, like the pendulum in its vibrations, or rather bearing resemblance to the *Leyden phial*, when it is alternately *charging*, *discharging*, and *discharged*.

When the sum of the stimuli acting upon the contractile fibre is too great, the fibre loses more irritability than it receives, and of course in a short time finds itself

self in a state of EXHAUSTION, and *this exhaustion* will be either,

1. *Temporary*, or
2. *Irreparable*.

1. In the state of *temporary exhaustion* the fibre fails for want of IRRITABILITY. The application of the ordinary stimulus, while it is in *this state*, will not make it contract. It is only by little and little that the fibre recovers its IRRITABILITY. This truth, I dare venture to say, is *as new* as it is *striking*, and it unfolds a vast number of phænomena hitherto inexplicable.

Let us observe, for example, the *tremulous writing* of old men, or *the motion* of the heart;—*the heart* contracts from the stimulus of the blood, and impels the blood through the arteries; it then again dilates, and the blood enters. But *the heart* does not contract itself *immediately* upon the first impression of the blood. Its IRRITABILITY having been lessened by the preceding contraction, it requires half, or three quarters of a second, before the IRRITABILITY of the heart shall have been recruited to such a degree that the same stimulus can act upon it.

The periods of women are explained on the same principle. The stimulus of the ovaries acting continually in them after the age of puberty (as I shall prove elsewhere),



elsewhere), nevertheless, does not produce its effects till the end of eight and twenty days; because this period of time is necessary for the uterus, in its state of health, to *accumulate* its IRRITABILITY in sufficient quantity for the stimulus to act; the discharge ceases after the irritability of this organ has been diminished, and returns with the returning irritability.

Thus during the operation of an emetic or cathartic, the stomach and bowels is *alternately* in a state of *excitement* and *repose*. And thus the most violent pains and labour of a parturient woman, if not effectual for the expulsion of the offspring, *cease* for a time, and are then *renewed*. Thus likewise all the appetites are liable to fits, returning after cessation at stated periods; if it be hunger, at the distance of some hours; if it be fever, it may be explained on the same principle; that is to say, any stimulus which is always present, and continually acting upon the fibres, produces no sensible effect, till the *exhausted irritability* of the fibre shall have *accumulated* afresh.

You can scarcely touch the leaf of the *mimosa pudica*, or *sensitive plant*, so slightly as not to make it close. The large rib which runs along the middle of the leaf, serves as an hinge on which the two halves of the leaf turn on

being touched, till they stand erect, and by that means meet one another. The *slightest touch* gives this motion to one leaf; if *a little harder*, it gives the same motion to the leaf opposite. If the touch be *still rougher*, the whole arrangement of leaves on the same rib close in the same manner. If it be *stronger still*, the rib itself moves upwards towards the branch on which it grows. And if the touch be yet *more rough*, the very branches shrink up towards the main stem.

In August, one of these plants growing in a pot was put into a carriage. The motion of the carriage caused it to shut up all its leaves, and the effect of *this great stimulus* was, that it did not again *expand* its leaves for more than four and twenty hours. A TORPOR then ensued: for having opened their leaves, they *closed* no more for three days and as many nights.—Being then brought again into the open air, the leaves *recovered* their natural motions, *shutting each night*, and *opening in the morning*, as regularly as ever.

All the *periodical motions* of plants and animals, as well as their *periodical diseases*, may be explained upon the same principle; that is to say, any *stimulus* which is always present, and continually acting upon the fibre, produces no sensible effect, till the *exhausted irritability*

of the fibre shall have been *accumulated* afresh. The *periodical motions* in organized bodies depend on the *alternate exhaustion* and *accumulation* of the *irritability* of the fibre. A *temporary exhaustion* of the *irritability* of the *bedysarum gyram* is produced by the heat of the sun and by electricity. The electrical fluid *exhausts* in like manner the *irritability* of the *mimosa*.

Let us consider the stimulating or exciting power of *wine*. When a depressed man is insufficiently excited with the *natural stimuli*, and rises not, suppose, above 30 degrees in his excitement, a glass carries him up to 32 degrees, another to 34 degrees, and so forth, till after five glasses he is carried up to 40 degrees; he then finds himself well and vigorous in all his functions. But still we are not so flimsily made, as not to bear a little of what is either *too much* or *too little*. Suppose he then takes five glasses more, and consequently is raised to 50 degrees. As his spirits, his intellectual, and all his other functions, were low, while his excitement remained at 40 degrees, so are they all proportionally exalted by the time that his excitement is elevated to 50 degrees. Let him still go on, and his intellectual functions will rise still higher; he will now display the full extent of his genius; and his passions and emotions of  
 whatever

whatever kind they be.—If he goes on, *how will the appearance be reversed!* The hero\* soon shrinks into a mere brute. He falls off in both his intellectual and corpo-

\* Vide the Elements of Physic. That JOHN BROWN perhaps caught the first idea of his philosophy from ARMSTRONG's Poem on *the Art of Preserving Health*, as before hinted, page 210 of this work, is in some measure confirmed, by comparing the above with the following lines. Speaking of *the effects of wine*, Dr. ARMSTRONG says,

“ Struck by the powerful charm, the gloom dissolves  
 “ in empty air; *Elysium* opens round.  
 “ A *pleasing phrenzy* buoys the lighten'd soul,  
 “ and *sanguine hopes* dispel your fleeting care;  
 “ and what are difficult, and what was dire,  
 “ yields to your *proweßs* and *superior stars*:  
 “ the happiest you, of all that e'er were mad,  
 “ or are, or shall be, could this folly last.  
 “ But soon your *heaven is gone*; a *heavier gloom*  
 “ shuts o'er your head: and, as the thundering stream,  
 “ swoln o'er its banks with sudden mountain rain,  
 “ sinks from its tumult to a SILENT brook;  
 “ so, when the *frantic raptures* in your breast  
 “ subside, you languish into mortal man;  
 “ you SLEEP,—and waking find yourself undone.  
 “ FOR PRODIGAL OF LIFE IN ONE RASH NIGHT  
 “ YOU LAVISH'D MORE THAN MIGHT SUPPORT THREE DAYS,  
 “ A heavy morning comes; your cares return  
 “ with tenfold rage, &c.

BOOK IV.

It is not meant to derogate ought from the illustrious founder of *the new philosophy* of medicine: JOHN BROWN will ever retain his advocates, and the rancour of his enemies will prove how far he was the *original inventor* of this beautiful and coherent system. Another might, at a chance time, like a meteor, shine forth, but this light was soon lost in the thick gloom that overspread this branch of science; whereas, in the *theoretical* writings of JOHN BROWN, we see the effulgence of the noon-day. And if he was not always *practically* just, we have to lament the shortness of his career of life, and the vastness of that persecution that was invidiously raised against him.

real functions; his tongue, his feet, his eyes, his memory, fail him; and at last, deprived of all power of motion and sense, he sinks into an inanimate SLEEP.

If a grain of *opium* be swallowed by a person unused to such a strong stimulus, all the vascular system in the body acts with greater energy, all the secretions, and the absorption from those secreted fluids, are increased in quantity, and much pleasure is introduced into the system, independent of our ordinary train of thinking, which adds an additional stimulus to that already too great.

After some time *the excitability becomes diminished in quantity*, being expended by the great activity of the system; and thence when the stimulus of the opium ceases, the fibres will not obey their *natural stimuli*, and a *consequent torpor* ensues, as is experienced by drunkards, who, on the day after a great excess of spirituous liquor, feel tremor, palpitation of the heart, head-ach, and general debility. During this *torpor* (as will be proved when treating of Law III), an *accumulation of excitability* in the exhausted fibres takes place, which is so great, as to occasion a *second over-exertion* on the application  
even



even of the *ordinary stimuli*, and thus an *unequal balance* of the *excitability* and of the *natural stimuli* continues for two or three days, where the stimulus was violent in degree; and for weeks in some fevers, from the stimulus of contagious matters\*.

But if a *second dose* of opium be exhibited before the fibres have regained their natural quantity of due excitability, its effects will be much less than the former, because the *excitability* is in part *exhausted* by the previous excess of exertion. Hence all medicines repeated frequently gradually lose their effect. Thus aloetic purges lose their efficacy by repetition; and opium and tobacco, if not taken beyond their usual doses, cease to stupify and intoxicate those who are habituated to their use.

But when a stimulus is repeated at *such distant intervals* of time, that the natural quantity of *excitability* becomes completely *restored* in the acting fibres, it will then act with the same energy as, when first applied. Hence those who have lately accustomed themselves to large doses of opium or aloes by beginning with small ones, and gradually increasing them and repeating them frequently; if they *intermit* the use of it for a few days

\* Vide Part IV. The Sect. on *Fevers*.



only, must begin again with as small a dose as they took at first, otherwise they will experience the inconvenience of an over-dose\*.

2. The fibre is said to be in a state of *irreparable exhaustion*, when it does not recover its due degree of *IRRITABILITY*, and fails upon the application of the *proper stimuli*. All then is languor and debility. The actions within the body are insufficient for the maintenance of life.

The babe is a compound of matter, so organized as to be capable of being acted upon by various stimuli, necessary to the continuance of life; and immediately upon its birth the first stimulus it receives is a quantity of at-

\* A lady labouring under a cancer of her breast, was advised to the use of cicuta (hemlock); and she accordingly got a quantity of it in powder, and weighed out the doses of it for herself. She began with a small dose; and feeling no sensible effects from that, she went on increasing the quantity. By the time she had come to 60 grains, she had taken the whole parcel she had got from the apothecary, and therefore sent to him for a fresh parcel of the powder. She had in the interim been advised, that when she was to pass from one parcel to another she should begin with a small dose only; therefore, as she had taken 60 grains of the former, she would take 20 of the new parcel. But such was the effect of *intermission*, that these 20 grains had very nigh killed her. In 10 or 15 minutes she was affected with sickness, tremor, giddiness, delirium, and convulsions. Happily for her the sickness proceeded to a vomiting, which threw up part of the powder, or the whole, but notwithstanding this the delirium, and even the convulsions, continued many hours. Vide *Cullen's Materia Medica*.

mospheric air in the lungs; this, with the addition of some milk, or mild food, taken into the stomach, is all the stimulus it seems capable of bearing, at this period, consistent with life and health; the external senses cannot endure any strong action on them; hence the tympanum, or drum of the ear, is kindly covered for some time after birth with a thick mucus occasioning deafness, and the eyes are shut against, or turn from, the impression of strong light. In this state, as was before shewn, there is the *keenest irritability*; the smallest stimulus, even that of the air of a chamber, more especially the purer and colder air abroad, and the mildest food, so act upon it, and exhaust it, as to produce almost constant sleep\*. From day to day the *irritability* of the fibre gets *diminished*, as is known to us by the circumstance of the same stimulants having a lesser effect on the fibre, in proportion as we advance from infancy to puberty, and from puberty to manhood. At this period of life, viz. about 35 years of age, it appears that there exists, as it were, a just equilibrium between the powers of the *ordinary stimulants* and the *irritability* in the muscular fibre; yet, at the same time, as the continued application of the ordinary stimuli is absolutely

\* Vide Law III. *On the Accumulation of Irritability*; also page 140.

necessary

necessary to life and health; so the daily effects of these is a small degree of *exhaustion of irritability*, and the state of health and periodical sleep. But again, according to the organization of our bodies, though sleep restores the healthy state of *irritability* in a certain degree, yet it seems never to restore actually *the former state*; a small degree of *exhaustion of irritability* takes place every year. This gradual change, consequently, not only indicates the power of bearing, but also the necessity of the application of stronger stimuli, as we advance in life, until, at last, that state takes place which we call *old age*, which is little affected by the ordinary, and scarce sensible of the stronger stimuli; and as these gradually cease to make the impressions necessary to the continuance of life, *the death of old age* must take place; which happens to mankind at different periods of life, earlier if they have given themselves up to pleasure and a variety of excesses, and later with those who have followed a moderate way of living, and been generally temperate in their excitements.

The *state* of the frame in consequence of *frequent inebriety*, or of daily taking *too much vinous spirit* without inebriety, consists in the *paralysis* which usually succeeds long and violent excitement. Sometimes the stomach  
is

is more materially affected, and *paralysis* of the lacteal system is induced; whence a total abhorrence from flesh-food and general emaciation. In others the lymphatic system is affected with *paralysis*, and dropsy is the consequence. More frequently the secretory vessels of the liver become first *paralytic*, and a *torpor* with consequent gall-stones or schirrus of this viscus is induced with concomitant jaundice; otherwise it becomes *inflamed* in consequence of *previous torpor*\*, and this inflammation is frequently transferred to a more sensible part, which is associated with it, and produces the rosy eruption of the face, or some other eruption on the head, or arms, or legs. In some enebriates the *torpor* of the liver produces pain without schirrus, gall-stones, or eruption, and in these epilepsy or insanity are often the consequence. All which will be more fully explained in Part IV. of this work.

The same effects arise from an imprudent use of TONIC REMEDIES. We have a very remarkable instance of this in the history of the *Portland Powder*, called so from its having cured, of an hereditary and inveterate gout, one of the dukes of that name. It consists of equal parts of the following herbs, viz.

\* Vide Law III. On the Accumulation of Irritability.

Take the roots of round BIRTHWORT,

\_\_\_\_\_ and GENTIAN, .

The tops & leaves of small GERMANDER,

\_\_\_\_\_ lesser CENTAURY,

\_\_\_\_\_ and ground PINE. Equal parts. Powder  
them.

A dram of this powder was ordered to be taken, in some convenient liquid, in a morning, fasting, the patient tasting nothing for an hour and an half after it; it must be used in this dose for *three months* without the least interruption. Forty-five grains are to be taken daily in the same manner for the succeeding *three months*: half a dram every day for the next *six months*: and half a dram every other day during the *second year*.

From very ancient times down to the present, *aromatic bitters* have been recommended and employed for the gout; and as this remedy, on its first coming into use in England, seems to have been of service, and to have cured several, it might have been expected, had not its consequences been often found hurtful, that the use of it would have continued, and this disease would have ceased to be one of the opprobria medicorum. We find, however, that while at one period a course of bitters, prolonged above a year, has been in fashion in this disease;



case, at another it seems to have been entirely neglected; and this I can impute only to its being attended often with consequences more serious than the gout itself. That the latter was the case, we may presume from the accounts of the ancients, who, though they recommend the remedy in *certain constitutions* as highly beneficial, allow that in other cases it has been as highly pernicious.

In nine instances, says Dr. CULLEN, I had occasion to know, or to be exactly informed, of the fate of persons who had taken the *Portland Powder* for the time and in the quantities prescribed. These persons had been liable for some years before to have fits of a regular or very painful inflammatory gout; but after they had taken the medicine for some time, they were quite free from any fit of inflammatory gout; and particularly, when they had completed the course prescribed, had never a regular fit, or any inflammation of the extremities, for the rest of their life. In no instance, however, was the health of these persons tolerably entire. Soon after finishing the course of their medicine, they become valetudinary in different shapes; and particularly were much affected with dyspeptic, and what are called nervous complaints. In those whom I knew,



some hydropic symptoms appeared, which gradually increasing in the form of an ascites or hydrothorax, especially the latter joined with anasarca, in less than two, or at most three years, proved fatal. These accidents happening to persons of some rank, became very generally known in this country, and has prevented all such experiments since.

ANIMAL and VEGETABLE POISONS *exhaust* in like manner, but with more expedition, the *irritable principle* in the fibre.

I procured, says FONTANA, fifty of the strongest and largest frogs I could meet with. I preferred these animals because they are livelier than others; because they die with greater difficulty; and lastly, because their muscles contract even several days after they are dead. I had each of them bit by a *viper*, some in the thigh, others in the legs, back, head, &c. Some of them died in less than half an hour, others in an hour, and others again in two and three hours. There were likewise others among them that fell into a languishing state, their hind legs that had been bitten continuing very weak and *paralytic*. In some of them I contented myself with introducing cautiously into a wound, made with a lancet at the very instant, a drop of venom.

These

These last lived longer than those I had had bit ; neither of them however escaped. A short time after these animals had either been bit, or wounded and venomed, the *loss* of their *muscular force* was very evident. When they were set at liberty, they no longer leaped, but dragged their legs and bodies along with great difficulty, and could scarcely withdraw their thighs when violently irritated : by degrees they became motionless, and *paralytic* in every part of the body, and, after continuing a very short time in this state, died.

I now opened the abdomen, and stimulated the nerves that pass through it in their way from the vertebræ to the thighs. I employed the strongest corrosives, but could excite no motion or tremulus in the lower extremities. I pricked the muscles with as little effect, and thrust a long pin into the spinal marrow, without producing any motion or trembling either of the muscles or limbs. In none of these parts was there a vestige of *sensibility* or *irritability*. The nerves were no longer the instrument of motion. The muscles no longer contracted, or were sensible to stimuli. The heart alone, in a few of them, continued to move languidly, and its auricles were filled and *blackened* by the blood which it seemed incapable of dispelling.

dispelling. This motion, and these oscillations, were however but of short duration.

Persons have been met with, who having been bit by a viper, have remained *paralytic* in some particular part of the body during life. A short time ago a woman in TUSCANY, who had been bit in the little finger by a viper, became, after various other complaints, *paralytic* throughout the whole right side of her body, and could never be cured. In a word, it is certain that all those who have met with this accident complain soon after of an *universal weakness*. Their muscles refuse their office. They become dull and heavy, have no longer the free exercise either of body or mind, and fall insensibly into a kind of *lethargy*: so true it is, that this venom induces a *palsy* of the muscles, and robs them of their active property, called by the moderns *animal irritability*.

The *aspic* also kills by occasioning a sudden *drowsiness* and *universal weakness*, followed by death, in the animal struck by it. Hence it seems that all the poisons supplied by the animal kingdom, occasion death by *exhausting* the *irritability* of the moving fibres.

But of all the poisonous animals hitherto known, the *polypus* seems to possess the most powerful and active  
venom.

venom. However irritable these creatures may be in other cases, and difficult to kill, the *polypus* succeeds instantly in extinguishing the principles of motion and life in *water-worms*. What is very singular, its mouth or lips have no sooner touched this worm than it expires, so great are the force and energy of the poison it conveys into it. No wound is however found in the dead animal. The *polypus* is neither provided with teeth, nor any other instrument calculated to pierce the skin, as I have assured myself, says FONTANA, by observing it with excellent microscopes.

If we reflect on the effects of OPIUM, its mode of action will also clearly illustrate this subject. That vegetable juice, if taken in a *large dose*, begins by rendering an animal weak and torpid, and soon kills it by *exhausting* the *irritability* of the muscular fibres, as I have several times observed in animals with cold blood, and as the famous BARON DE HALLER demonstrated a long time ago, even in those that have the blood warm.

The symptoms and accidents that follow *the bite* of the *viper*, do not differ essentially from those I have just spoken of, and may at least induce one to suspect that the venom of that animal likewise kills by totally destroying the *irritability* of the fibres.

Both

Both of them act by exciting violent *convulsions*\* and *vomiting* †. Each conveys an *universal debility* into the organs. They render the muscles *paralytic*, make the animal *heavy*, and finally bring on *lethargy*

\* *Convulsions* appear to arise, says FONTANA, from the destruction at different times, and in an irregular manner, of the *irritability* of the muscular fibres. It has been unjustly attributed to a superabundance of animal spirits. Weak languishing animals, that die from hunger, perish in dreadful convulsions. It is besides certain, that men and women of a delicate and weak frame are always the most subject to convulsions; and it is not possible to suppose in these persons superabundance of animal spirits.

We know that all the muscles, even in a relaxed state, preserve notwithstanding a *certain tension* of their fibres, which, when they are cut, never fail to contract themselves and enlarge the wound. When a muscle becomes paralytic it lengthens, and its antagonist then contracts the more; which shews that repose of the muscles depends on the equilibrium of strength betwixt the different muscles, and betwixt their different fibres. The powers *thus balanced* destroy and renew themselves at every instant, without producing any motion or sensible change. This *natural tension* of the muscular fibres arises either from the nervous electricity (see Part I. Sect. XII. p. 114), or from the exact distribution of *well oxygenated blood* in the whole substance of the muscles. If these muscles do not receive the same proportion of *well oxygenated blood*, or if the *arterial blood* be distributed with an unequal quickness and energy amongst them, the *equilibrium* of the mutual efforts of the muscles is immediately destroyed; the strongest of them contract; and hence arise *convulsions* and *agitations* of the whole frame. It is for this reason, that those who die of an hæmorrhage, as well as those who perish by poison, or by breathing mephitic airs, are seized with *convulsions*: for it certainly is not probable that the loss of blood, and of strength, should bear an *equal proportion* in every part, in every muscle, and in every fibre, whilst the *circulation* itself is *unequal*, and the *principle of irritability* is dependent on, or derived from, the *blood*.

† Those who breathe for any length of time mephitic air are seized first with faintness, and if life becomes not immediately extinct, are attacked with vomiting. Vide Part I. p. 50.



and *death*. It avails nothing to animals with cold blood, that they are endued with an obstinate life, and are capable of preserving that, as well as motion, after they are cut to pieces. If either of these poisons attacks the principle of their motion, that is, destroys OXYGEN upon which the IRRITABLE PRINCIPLE depends, they die speedily, all motion is annihilated in them, and their parts will no longer give any signs of life. Their body, it is true, will preserve its organization; but an organized body that has lost its motion, is truly a body without life, and the body then differs in nothing from a fossil, or any other dead matter, for all this assemblage of vessels, so many different organs, and this astonishing structure of parts, are no longer of any use to the animal, and should be regarded as not existing, for without IRRITABILITY, there is neither sensation nor life.

It may not be amiss here to inquire a little into the foundation of that *memorable doctrine* maintained by some philosophers, “ THAT OXYGEN IS THE PRINCIPLE OF IRRITABILITY, AS IRRITABILITY IS THE PRINCIPLE OF LIFE.” Vide *the Memoirs of GIRTANNER*, p. 211; and the Rev. Mr. TOWNSEND’S *Guide to Health*, p. 306.



## SECT. XXXVI.

## OF OXYGEN AS THE PRINCIPLE OF IRRITABILITY.

Perhaps from *the new chemistry*, which is daily unfolding the profoundest secrets of nature, and, among the rest, the delicate play of living machinery, a method may be devised of restoring IRRITABILITY to the system. The Materia Medica was *formerly* supposed to contain distinct specifics for the diseases of each separate organ; it is *now* regarded as little else than a collection of evacuants and stimuli; so that medicine is become in a great measure the art of administering drams. Hence it can often only amuse or palliate, and must sometimes injure, by forcing into motion constitutions already too much worn. How would our resources be multiplied, if we could give IRRITABILITY as well as STIMULANTS! “*But is so salutary a revolution in medicine possible?*” I do not know; but it is worth while to enquire.

Dr. BEDDOES.

AFTER having proved that the venom of the *viper*, *aspec*, &c. occasion death by destroying the IRRITABILITY of the fibres, we should next examine THE CONDITION OF THE BODY WHEN DEPRIVED OF THIS PRINCIPLE.

The truly *constituent principles* of vegetables are three,

1. HYDROGEN,
2. OXYGEN,
3. CARBON.

I call these *constituent parts*, says the celebrated LAVOISIER, because they are common to all vegetables,

and

and because no vegetables exist without them; and by way of distinction from other *substances* which are essential to the constitution of some particular vegetables, but not to all.

Of these *three principles*, two of them, namely HYDROGEN and OXYGEN, have a great tendency to unite with CALORIC, or *matter of heat*, and it takes in consequence an *elastic form*, or *gas*;—while the CARBON, on the contrary, is a *fixed principle*, and has very little affinity or desire to combine with *the matter of heat*.

On the other side, the OXYGEN, which tends to unite with nearly equal forces either to the HYDROGEN or the CARBON in the *ordinary temperature*, has on the contrary greater affinity with the CARBON at a *red heat*: the OXYGEN consequently quits *at this degree of heat* the HYDROGEN, and unites with the CARBON, and forms FIXED AIR.

Although we be far from knowing the degree of these forces of affinities, and from being enabled to express them by numbers, at least we are certain, from what passes daily before us, that however variable they may be with regard to the degree of temperature, they are all nearly in *equilibrium*, or, what is the same thing (from

the digestive \* and excreting † living powers), the *equilibrium* is always kept up at the temperature in which they exist; thus *vegetables* do not contain either OIL, or WATER, or FIXED AIR, but they contain THE ELEMENTS of all these substances ‡. The HYDROGEN is not combined, either with OXYGEN or with CARBON reciprocally; although in the living state the principles of these three substances form a triple combination, whence EQUILIBRIUM or rest result.

A very slight change in the temperature is sufficient to overturn all this entanglement of combinations.

If the temperature to which the vegetable is exposed does not much exceed that of boiling water,

1. The HYDROGEN and OXYGEN reunite, and form WATER, which passes in the distillation;
2. A portion of HYDROGEN and of CARBON unite together, and form a VOLATILE OIL;
3. Another portion of CARBON becomes free, and being the most fixed principle, remains in the retort.

\* The powers in the body which repair.

† Those powers which throw off superfluities.

‡ Mons. LAVOISIER does not mean to deny the existence of OILS altogether in vegetables; for some OILS may be expressed; and essential OILS evaporate spontaneously and by the heat of the air; and their existence is therefore evident. But the OILS of which he denies the previous existence are those only which are obtained by distillation.

But

But if, instead of a heat nearly equal to boiling water, a *red heat* be applied to vegetable substances, then WATER is no longer formed (or rather that WATER which may be formed by the first effect of heat is decomposed).

1. The OXYGEN unites to the CARBON, to which it has a greater affinity at this degree of heat, and FIXED AIR is formed ;
2. The HYDROGEN now becoming disengaged, escapes in the form of GAS, while it unites with THE MATTER OF HEAT.

At *this degree of heat* no OIL is formed, or if it were formed, it would be decomposed.

We see then that *the decomposition* of vegetable matters is effected, at this *degree of heat*, by means of *double* and *treble affinities*, and that while,

1. The CARBON attracts the OXYGEN in order to form FIXED AIR ;
2. The MATTER OF HEAT attracts the HYDROGEN, and they together form INFLAMMABLE GAS \*.

The

\* That vegetables are composed of HYDROGEN, OXYGEN, and CARBON, may be also proved by SYNTHESIS. If you put a pea into a bottle it will at a given temperature shoot out and branch itself into foliage. This cannot arise from the extension of parts ; for though a guinea may be beat  
out

The *distillation* of most vegetable substances furnishes a proof of *this theory*, if we are to give that name to the *simple declaration of a fact*.

The play of affinities is still more complicated in those plants which contain AZOTIC AIR, as the cruciform plants, and in those which contain PHOSPHORUS; but as these substances enter into combination only in a small quantity, they do not produce great changes, at least apparently, in the phænomena of distillation.

It appears, in the first place, that the PHOSPHORUS remains combined to the CHARCOAL, which renders it

out to cover a small room, yet will it have *no increase of weight*. Here it evidently has acquired *something*, and the question then naturally presents itself, "*Whence this addition?*"

It is exposed to nothing but WATER, HEAT, and AIR. It without doubt procures,

1. HYDROGEN from the *water*.
2. OXYGEN from the *same*, and likewise from the *decomposition* of
3. CARBONIC ACID AIR, which it imbibes. Vide page 29, note \*.

The *moisture* of the atmosphere may also supply some portion of WATER, to be decomposed and adjusted to the other principles.

As *large quarries of marble*, and *whole mountains*, are formed from the exuvix or shells of marine animals, so here do we see that the most *solid oaks*, &c. arise from the WATER of the earth and atmosphere, and the FIXED AIR thrown off from the combustion of the body, and other organized substances. *These truths*, equally *new* as they are *simple*, recal us to the FIRST CAUSE, who, by *differently* combining a few simple bodies, has infinitely diversified the nature and appearance of things. Some years back, and this doctrine would have been looked upon as the dream of a visionist, so opposed is *true philosophy* often to the ordinary conceptions of mankind!

*fixed*.—As to the AZOTIC AIR, it unites with the HYDROGEN, and forms VOLATILE ALKALI\*.

*Animal matters* being compounded nearly of *the same principles* as the cruciform plants, give nearly the same results in distillation; but as they contain more HYDROGEN, and more AZOTIC AIR, they furnish larger quantities of OIL and VOLATILE ALKALI.

In vegetables and animals possessing life, there is an express *organization of parts*, which evidently appears to have been designed by the SUPREME INTELLIGENCE for the purpose of uniting the powers of *mechanism* to those of *chemistry*. In this point of view, we may consider *the solid and consistent parts of vegetables and animals* as composing an *apparatus* for performing a number of CHEMICAL PROCESSES with *the fluids* that circulate through them†. It is true, indeed, that this whole series of operations is, for the most part, performed with such a minute set of vessels; at the same time that the principles applied to each other, to exercise their respective chemical attractions, seem in general to be so powerfully

\* Vide Part I. p. 27.

† That the *living organized machinery* accomplishes all *these miracles*, as they seem to us, we have a *beautiful example* in the process of ENGRAFTING, where



powerfully influenced by the vital principle, that in *the present state* of our knowledge, we can scarcely proceed farther than to assert, that the effects are really produced by an application of the MOST SUBLIME CHEMISTRY: but *these difficulties* ought rather to encourage than depress our attempts to arrive at a more intimate knowledge of the powers of nature.

In the healthy living body *the balance of principles* is constantly kept up, by *the surface* discharging the superabundant AZOT and the useless AQUEOUS FLUID (*hydrogen and oxygen*), AMMONIACAL SALTS (*azot and hydrogen*), and PHOSPHORIC ACID (*phosphorous and oxygen*);—

where the *four juices* of a CRAB, by passing through the *chemical apparatuses* of the *engrafted part*, is made to produce the *most delicious FRUITS*. So in the animal world, the *spur* of a cock being taken off by JOHN HUNTER, and *engrafted* (if I may be allowed the expression) in the forehead of another bird, the juices of the latter, by pervading it, gave it life and growth.

Are we staggered, that a *few principles, differently modified* by chemical processes, should produce such an *immense variety*? Here let me remind the young student in philosophy, that 1 *part* OXYGEN, with 4 *parts* AZOT, loosely combined and suspended by CALORIC, is *atmospheric air*, and that 4 *parts* OXYGEN and 1 *part* AZOT, in a state of combination, which may be easily effected, by passing the electric fluid repeatedly through a jar containing these proportions of the two airs, suspended by CALORIC, is *nitrous air*;—that the *former*, blended with WATER, is the beverage of common life, the element designed for fish—whereas the *latter*, combined with WATER, is AQUA-FORTIS, which corrodes and destroys every thing; so much do *the nature of things* depend on the *proportions and combinations* of the FIRST ELEMENTS. Vide note \*, page 385.

by

by the lungs throwing off CARBON and HYDROGEN, and *the blood* in the lungs and the *absorbents* of the skin taking into the system VITAL AIR (*oxygen* and *caloric*), while *the lacteals* of the intestines imbibe all THESE SEVERAL PRINCIPLES. The *just balance* of *these principles* in the body constitutes HEALTH and LIFE, or, more properly speaking, *is the condition necessary for the maintenance of LIFE.*

When the balance gets broken, a loss of HEALTH or DEATH ensues.

We are now to investigate, as far as we are able, “*the condition of the body when deprived of the IRRITABLE PRINCIPLE, by the venom of the viper, opium,*” &c.°

The diminution of *irritability* in the muscular fibres, in those animals bitten by the VIPER, is occasioned without doubt by the destruction of *the right balance* of *the principles* in the system.

*The blood* partly *dissolved*, and partly *coagulated*,—from being *red* becomes *black* or *brown*,—from being a *bland fluid* contained within numerous vessels, it becomes a *perfect caustic*, which dissolves the texture of the containing vessels, passes through their coats, and sheds itself in the adipose membrane, corrupting and decomposing whatever it meets with.

The part in which the wound has been inflicted passes, in the shortest time, into the *strongest putrefaction*, and presents a perfect *gangrene* and *spacclation*.

The *skin* is speedily *corroded* and *livid*, and the *muscles* become *black* and *fætid*.

I have known a rabbit die in less than three hours, with the *muscles* of the leg already gangrened throughout their whole substance; they were *black* and *offensive*, and were divided by a knife without any resistance. After death the flesh was *softened* so much as to crumble at the least touch, and even without violence fell from the bones. Upon opening its body I found the blood in all the cavities of the heart *black*, and often coagulated\*; but the most remarkable change was in the *lungs*, which was filled with *black* blood, and exhibited every where *livid spots*.

This *black appearance* of the blood, especially in the lungs, would lead one to suppose, that the OXYGEN of the blood, which we have before shewn gives it its *crimson colour*, had entered into some new state of combination, and with it the *irritable principle* itself was fled.

We will now see how it affects the blood when drawn from an animal.

\* In this case the *irritable principle* in the blood was not wholly destroyed, for when *that* is the case it is *fluid*. See page 392, line 3.

I let fall, says FONTANA, into a small conical glass, *three drops* of the venom of the viper, and *twenty drops* of the blood that flowed from the neck of a fowl, into which I had made an incision. I reclined the glass, and shook it circularly for ten seconds, that the venom and blood might mix well together.

At the same time I let fall into a similar glass, *twenty drops* of the blood of the same fowl, in the same state as the last. I shook the glass, as I had done on the preceding occasion, that, the venom excepted, all circumstances might be alike.

At the end of two minutes, *the blood unmixed* with the *venom* COAGULATED, and was of a FINE VERMILION COLOUR.

On the contrary, the *blood united* to the *venom* was BLACK and FLUID.

I repeated this experiment next on the blood of a Guinea pig. The *venomed blood* at the end of twenty-four hours was still BLACK and DISSOLVED, whilst *the other* COAGULATED in less than two minutes, and continued to preserve its BRIGHT RED COLOUR.

The *venomed blood* did not harden, but it dried by degrees, and split into scales, and preserved its BLACK COLOUR till the last; instead of which, *the blood in its*

*natural state* still continued RED, even after it had dried and split.

It is the same with VEGETABLE POSONS. We find that the flesh of animals which has been cut with a knife dipped in the juice of napel, instantly becomes more *tender*, and fitter for culinary purposes. Travellers inform us that in both INDIES, as well as in AFRICA, the inhabitants usually hunt with *poisoned arrows*, and that in the space of six minutes, or more or less, according to the degree of the poison's activity, these arrows kill the largest animals, such as lions, tygers, and even elephants. They likewise observe that the flesh of these animals immediately *softens*, and becomes *tender*; an unequivocal proof that all these poisons equally dispose the flesh to a speedy putrefaction, by a destruction of the proper balance or adjustment of the constituent principles.

I procured, says FONTANA, by favour of Dr. HEBERDEN, the poison with which the Americans fatalize their arrows, called TICUNAS.

I put into the syringe, for the first experiment, *four drops* of an aqueous solution, which scarcely contained *half a grain* of the dried poison. Having introduced the point of the syringe into the jugular vein of a large rabbit, I perceived the liquor to flow back on the moment  
of



of my pushing the sucker, owing to its not being exactly fitted to the sides of the syringe : I observed to the persons present, that the experiment had failed, but was surprised to hear in reply, that *the animal was dead*. I do not think ten seconds passed betwixt the time of the liquor's flowing back, and the death of the animal, which had actually taken place. I cannot estimate the quantity of poison introduced into the blood, but as the animal died, some must necessarily have found its way thither ; had not this happened, I should have supposed, from the quantity which flowed back into the tube, that not a single drop of it had entered the jugular vein.

Having put my syringe in better order, I introduced, says he, *two drops* of water, with which I had previously mixed about *a quarter of a drop* of the aqueous solution of the poison I have spoken of. I scarcely began to inject this liquor by the jugular, when the rabbit fell, without motion and without life, as if struck by lightning. I do not think *half a drop* was introduced.

The death of these animals was *more sudden* than in the cases of introducing in a similar way the venom of the viper into the blood ; and the whole body was more *sunk* and *relaxed*, the limbs being rendered as *pliant* as in animals that have been dead a long time. In animals  
bit



bit by the viper, the blood is often coagulated in the vessels, and partly fluid; in those destroyed by the ticunas it is always *fluid*. As the *coagulability* of the blood is governed by the same laws as the *irritability* of the fibre \*, this is what we might expect; and we find also, that the venom of the viper cannot overcome the irritability of cold blooded animals, whereas the poison of the ticunas is *fatal* to almost every species of animal †. The muscles of the animals who are killed by the ticunas appear remarkably *pale*. The blood in the venous vessels near the heart is *darker* than usual, and not *coagulated*. The abdominal viscera is not sensibly changed. But I observed, says FONTANA, a great change in the *lungs*, a viscus very essential to life. I generally found it more or less *spotted*; the spots were frequently *very large* and *livid*.

This change in so noble an organ deserves the utmost attention. It was nearly the same with respect to the

\* Vide page 353, line 3.

† Except the viper and adder, which are *peculiarly* tenacious of life. Adders and vipers may be cut into pieces, and so tenacious are they of *life*, that each part will remain for a long while *irritable*. This principle is so predominant in their nature, that few poisons are able to overcome it. Some adders, upon the application of the ticunas, seemed indeed, however, less lively than usual, and the hinder part of the body, which was wounded, became *numbed*, and *lost* its *natural motion* in a sensible degree, and that for several hours; but none died from this poison.—FONTANA.

venom of the viper \*. The air within the cells was very visible through the external membrane, when examined with a microscope; and upon a puncture being made, it escaped through the opening.

I next wished to examine, whether the American poison produced any sensible alteration in the blood of animals, if mixed with it on its issuing warm from the vessels.

For that purpose I cut off a pigeon's head, and received the warm blood in two small conical glasses a little heated, about eighty drops in each glass. In one of them I put four drops of water, and in the other four drops of an aqueous solution of the ticunas, containing scarcely a grain of the dried poison. I shook each of the glasses for a few seconds, so as severally to unite their contents; in two minutes the blood mixed with the simple water was *coagulated*; that with the poison did *not coagulate*; but became of a considerable *darker* colour, and in three hours was still in a fluid state, whilst in the other glass the serum and coagulum were distinct.

To have no doubt on this subject, I then tried this poison on parts that are known to possess *no irritability*;

\* Vide page 390.

and I found, says he, that the tendon of a muscle being venom'd did not produce the disease of this poison.

I then applied the ticunas to the *nerve itself*, but in whatever way the experiments were diversified, it does not produce under such trials any derangement in the œconomy of the living animal.

I next separated the *nerve* going to the thigh, so that the nervous influence was destroyed: but the venom applied to the muscle of the leg, nevertheless, *extended* its influence over that limb to the rest of the body.

The AMERICAN POISON then agrees with the VENOM of the VIPER, in being quite *innocent* to the *nerves* and *tendons*, in whatever way it be applied to them; but, like the viper's venom, it kills in the smallest quantity, if introduced into the *blood* by the jugular vein, or applied to a *muscle*; and its action must therefore be altogether on the IRRITABILITY of the system.

It would be a curious investigation, at the present time, to enquire, “ *Whether those aerial bodies, which do not impart OXYGEN to the blood, produce somewhat similar phænomena with the above poisons, which have been proved to destroy THE IRRITABLE PRINCIPLE;*” if so,

we should obtain some ground for the belief “*that oxygen is the principle of irritability.*”

In the work of the celebrated TISSOT of *Geneva*, on the nerves, we find him hesitating much in admitting that *unrespirable factitious airs* kill by destroying the IRRITABILITY of the *heart* and *muscular fibres*. “One of the greatest modern naturalists,” says he, “thinks that their fatal effects are to be explained *on this principle*; but by what conveyance can their powers reach the heart? How can *fixed air* kill this way, since, when taken into the stomach, or applied to the muscular fibres of the intestines, it revives their action, and awakens as it were the very principles of life?”

FONTANA endeavours to overcome this difficulty, by saying that TISSOT ought to have had recourse to *experiment*, to which an authority of so great weight as this benevolent and able physician’s is but too capable of preventing an application. The difficulty here opposed is, that we do not know the channel by which *mephitic airs* deprive the heart of its IRRITABILITY. But it must be acknowledged, continues FONTANA, that the ignorance of *one truth* does not exclude the knowledge of *another*; and that we may know the effects, and that it is so, without understanding the cause, and still less their

manner of acting. The question is reduced to this, to determine by experiment, “ *Whether these mephitic vapours destroy, or do not destroy, the irritability of the heart;*” and the difficulty proposed above is of no weight, whether we know or not the way in which this is brought about, provided the experiment be certain, and the illustrious writer oppose nothing which disproves it.

In consequence of these considerations, I formed to myself, says FONTANA, a resolution to try different mephitic gases, and to examine their effects on living animals. I was assisted by CAVALLO, in company with other philosophers. The result of all our experiments demonstrated, *that mephitic vapours kill animals, by destroying the IRRITABILITY of the whole muscular system.*

In one experiment I placed a frog in *unrespirable air* (such as does not impart OXYGEN to the blood). It died almost instantly, after making a few leaps, and being violently agitated. I opened, and found all its parts *flaccid and relaxed*. The *heart* still moved, but *feebly*, and with *great difficulty*, and in a short time entirely lost these slight remains of action. I endeavoured ineffectually to *irritate*, not only *that*, but likewise the *other muscles*; neither of them would contract. I forced a  
needle



needle into the spinal marrow, and saw, with surprise, that it no longer awakened the motion of the limbs. The *colour* of the *red blood* was also wholly changed to a *brown*.

I placed two frogs beneath a glass recipient, into which I had introduced the gas obtained from a solution of iron-filings in the nitrous acid. They also died instantly. I opened them, and found the *arterial blood* of a *brownish hue*, and collected in the auricles. The *heart* was no longer in motion, and was *insensible* to *stimulations*. The flesh was thoroughly *flaccid*, and had lost *all irritability*. On pricking the *crural nerves*, the leg remained *motionless*.

The illustrious GIRTANNER injected into the jugular vein of a dog a small quantity of *azotic air*. The animal died in twenty seconds. Upon opening the thorax, the pericardium, and the heart, the right auricle and ventricle were filled with *black blood*. The left ventricle was of its ordinary dark colour. The *heart*, and all the *muscles*, had *lost* their *irritability* almost entirely, and contracted but weakly upon the application of the strongest stimuli, such as the electric spark.

A small quantity of *carbonic acid gas* was injected into the jugular vein of a dog. The animal became sleepy,



and died in about a quarter of an hour. The right auricle and ventricle of the heart were filled with *dark blood*. The blood contained in the left ventricle and auricle was of a *deeper colour* than ordinary. The *heart* and *muscles* had *lost* all their *irritability*.

This *important subject* demands more *comparative experiments*, and made expressly for this purpose; and we could wish that a distinguished physician, who first brought this subject into repute in ENGLAND, would examine into it minutely, and extend this principal branch of modern medicine. We do not here demand fresh, sublime, and abstracted theories, which a singular effort of genius gave birth to: we are in need of nice observations; new and well-imagined experiments; direct and useful inductions, drawn by a calm mind, and one capable, like his, of assembling and combining in the best manner the most luminous particulars.

I cannot forbear mentioning in this place the singularity of a small microscopical animal, which LEWENHOECK has named *Rotifer, wheel-polypus*. It is a small gelatinous worm, commonly found in the earth or sand collected by rain in the tops of houses. I have likewise found it in other earths, as well as in waters that have been some time stagnant, and more frequently again in  
those

those that have a gentle current, and are filled with conserva, and other aquatic plants. This worm is divided towards its head into two tolerable sized trunks, which appear like two stars, from the number of small, extremely sharp, and short branches, which project from it. They really appeared to LEWENHOECK to be wheels of a rare mechanism, and every one would judge the same on seeing the creature put them in motion. But a more exact observation at length convinced me, that they are not wheels, but a quantity of moveable arms regularly planted all around the two trunks. It moves these one after another with so great celerity that the eye fancies it sees absolute wheels: but to be certain of the contrary, it is only necessary to place it betwixt two pieces of glass, and then observe it a long while together with an excellent microscope. In swimming it strikes the water with these arms or branches with incredible celerity, rests itself at different periods, and thus transports itself from one place to another. When it eats, it, on the contrary, fixes its tail in some substance, and afterwards turns its two wheels, giving such a motion to the water, that it directs the course of it towards its head, so that it presents to its mouth all the small corpuscles with which stagnant water abounds.

The

The *wheel-polypus*, I have spoken of above, loses when dried every kind of motion and appearance of life, and recovers both the one and the other when again put into water. I placed one of them on a bit of glass, which I exposed, during a whole summer, to the noon-day sun: it there became so dry, that it was like a piece of hardened glue. A few drops of *water* did not, however, fail to restore its motion and life. Lastly, I left it, by way of experiment, in a very dry soil, and exposed, during the summer, to the whole heat of the sun for the space of two years and a half. I afterwards returned it again into *water*, where, at the end of two hours, it recovered life and motion. The *water* appears in this case to be *decomposed* when it comes in contact with the animated fibre, the OXYGEN it contains combines with the fibres of the *rotifer*, restores its *irritability*, its life, and organic motion, of which it had been deprived by the excessive stimulus of heat, to which it had been so long exposed.

The microscopical eels that are found dry and withered in smutty wheat, recover motion and life as soon as they are wetted with a little *water*, and again become lifeless and dry, whenever they are no longer exposed to *water*. I have repeatedly assured myself of this with an extreme pleasure. Thus then do they preserve the  
power

power of reviving and resuscitating effectually, by the simple presence of the *water* with which they are moistened.

The celebrated BONGUER, in his work on the shape of the earth, relates to us, from the testimony of Father GUMILLO, a jesuit, that a large venomous snake is found in *Peru*, which being to appearance dead, and dried in the open air, or in the smoke of a chimney, has the property of coming again to life, on its being exposed for some days to the sun in a stagnant and corrupted *water*.

I have dried, says FONTANA, the worm called *feta equina*, or, according to LINNEUS, *gordius*, several times in the open air, without leaving it there too long: it had lost almost all its bulk and weight, and was become like a bruised and dry straw: its skin had shrunk so as to leave no sensible cavity, and it had no longer any sign of life and motion. I returned it into *water*, where, in less than half an hour, it recovered its bulk and weight, and soon afterwards discovered unequivocal and permanent signs of life. I have since found a number of other small animals, either on the tops of houses, in earths, or in water, which, in the same way, alternately lose and

recover the use of their organs on being dried, and afterwards returned again into *water*.

The physician ought not, however, to confound with each other these two different states ; that is to say, the putrefaction of the parts, and the desiccation of the organs. In the first the animal is dead for ever ; in the second it may yet again return to life. We do not know any power, Nature herself does not disclose any, that can recompose an organ that is destroyed and entirely decomposed and putrid. This is what has never yet been accomplished or seen. We have therefore every possible reason, not only to believe an animal that is reduced to this state *dead*, but likewise to believe it dead for ever. But if the animal is simply dry, if there is no physical disease in its organs, if the component particles of the different parts still preserve their respective situations, the animal may in this case very well return to life ; to which effect it is only necessary that the organs receive a sufficient degree of OXYGEN, which we know to be the principle of *irritability* and of *life*.

We have yet a stronger evidence of the doctrine advanced in this Section from the following experiments with the venom of the viper.

I pierced,



I pierced, says FONTANA, one of the fore feet of a land *turtle* that weighed four pounds, with an American arrow, which I left there for half an hour. In another hour it scarcely seemed alive, and in two appeared quite dead. After an interval of ten hours, I removed with a sharp instrument the inner shell, taking care that all the fleshy parts should be as little torn as possible. The heart was still, and I scarcely found any motion in the auricles. But to my great surprise, the heart, together with the auricles, *recovered* all their force, and continued in strong action six hours incessantly; the auricles kept in motion two days, that is to say, as long as they moistened by OXYGENATED BLOOD which flowed from the neighbouring arteries.

I then pierced the fore foot of a land *turtle* that weighed a pound and a half with an American arrow. In eight minutes it could scarce move, and in a quarter of an hour was to all appearance dead. When the feet and neck were stimulated, they discovered a slight degree of sensation. Having opened the thorax, I found the heart and auricles quite motionless. I touched the heart thrice, and it contracted itself once each time. On freeing it from the membranes, it began to move very briskly, and continued to do so for several hours. I



covered it with the inner shell, and in twenty-four hours found it again motionless. I pricked it once with a needle, it contracted itself but a single time; I pricked it again, it contracted itself afresh, and continued to do so every time I pricked it. I left it exposed to the *air* for three minutes, and it then began to move itself, continuing a very brisk motion for several hours. I covered it afresh with the shell, and on uncovering it four hours after, found it motionless. I then left it again in the *pure air*, and in a short time, and of itself, it recovered its oscillations, which continued for six hours. I again covered it with the shell, and on uncovering it two hours after, found it without motion. I then covered it with *water*\*, which I kept on it for ten minutes, without its producing any change. I drained off the water, and the heart was scarcely left in the *air* a minute, when it began afresh to move briskly, and continued to do so several hours.

This succession of motion in the *turtle*, deprived of its IRRITABILITY by the poison of the *ticunas*, produced by the simple contact of *atmospheric air*, if it does not

\* In this case no decomposition of the water took place; but it proves that it was not *moisture* in the first experiment that *re-excited* the movements of the heart.

decisively

decisively prove that the IRRITABLE PRINCIPLE is derived from the OXYGEN of the *air*, it nevertheless goes to prove, that *the air* is a very *active principle* in *awakening* the IRRITABILITY of the *muscular fibres* and of the *heart*, as was maintained in Section XXXII. page 340.



*SECONDLY,*  
OF  
INDIRECT STIMULI.



## E C T. XXXVII.

## LAW III.

A DEFECTIVE STIMULATION OF ANY ORGAN ACCUMULATES IRRITABILITY IN THE MOVING FIBRES.

THE *blood vessels*, the *absorbents*, the *stomach*, and *intestines* (which might, without much impropriety, be called HOLLOW MUSCLES), are in *constant action* from the *stimuli* appropriated to them. The LOCOMOTIVE MUSCLES, when not acted upon by the *nervous electricity*\* darted into them by the will, are nevertheless in *constant action*, as is seen in the tremor of old men, in the palsy of the head, and from the contraction of an-

\* The *celerity* of *electricity* keeps pace with the *celerity* of *volition*, and therefore seems peculiarly adapted to explain the phenomena of the nervous system. When LOUIS the XVth, from a motive of curiosity, commanded a battalion of 2000 men to stand hand in hand, to receive the electric circuit through their bodies, the last man felt the shock at the same instant with the first. So in the act of volition, the moment the mind wills the hand to be moved,\* it is moved; but without our being conscious of the manner how; because it was not necessary we should know it was done by the mind directing the nervous electricity into the moving fibres of the part. Vide Part I. Sect. XII.



tagonist muscles, when those which counterpoise them are cut through, or lose their action (called by HALLER their *vis insita*), from a paralytic affection. Vide note\*, Vol. I. page 128.

The IRRITABLE FIBRE therefore, from the moment of its existence to that of its dissolution, being constantly surrounded by principles which act upon it, and stimulate it, and upon which it re-acts, it follows, that during the period of its existence, the IRRITABLE FIBRE is in *continual action*; that its existence consists in *action*, and that it is not in a passive state, as some authors have asserted.

*The continued actions* going on in organized animated beings *expend* the IRRITABLE PRINCIPLE in the fibre, whether THAT be,

- 1st. OXYGEN derived from the blood;
- 2d. ELECTRICITY; or some as yet
- 3d. UNPERCEIVED POWER in the fibre.

PROP.

## PROP. I.

If the *supply* of the IRRITABLE PRINCIPLE to the moving fibre, be *equal* to the *expenditure* by the action of stimuli, the fibre is then said to be in a state of TONE.

## PROP. II.

If the *expenditure exceed* the *supply* of THIS PRINCIPLE to the fibre, it is said to be in a state of EXHAUSTION\*.

## PROP. III.

But if the *supply* given to the moving fibre *exceed* the *expenditure*, the fibre is then said to be in a state of ACCUMULATION.

\* These propositions have been proved in the foregoing part of the work.

## SECT. XXXVIII.

## OF COLD.

DURING the winter, by the absence of the stimulus of *heat*, and in part of *light*, plants and many animals become *torpid*, the organs of circulation, and of nutrition, perform their functions but languidly, and life itself appears suspended. In consequence of *the diminished action of these stimuli*, THE IRRITABILITY *accumulates*, and manifests itself at the return of *spring*. A slight degree of heat *then* produces powerful effects upon the fibres thus *delicately irritable*. Animals, which had concealed themselves under ground, even when the cold is greater than in autumn, venture forth from their subterraneous retreat, trees and plants put forth their leaves and blossoms, and birds, and animals, and man himself, is sensible of the stimulus of heat from the return of *spring*, his fibres being rendered *more irritable* by the winter's cold.

Dr. HALE, in his *Vegetable Statics*, relates that he cut down a vine, and cemented to its mutilated stump glass tubes, each 7 feet long, and one fourth of an inch  
 7 diameter,

diameter, with brass caps, by which they were screwed on one above another, till they rose to the height of 36 feet.

By these gages it appeared,

- 1st. That the *sap* began visibly to *rise* MARCH 10, when the thermometer by day stood only at 3 *degrees* above the *freezing point*;
- 2dly. That, APRIL 18, it was at *its height* and *vigour*;
- 3dly. That from *that time* to MAY 5th the force *gradually decreased*;
- 4thly. That it constantly rose *fastest* from sun-rise to about 9 or 10 in the morning, and then *gradually subsided* till about 5 or 6 o'clock in the afternoon;
- 5thly. That it rose *sooner* in the morning after *cool weather*, than after *hot days*, and in *proportion* to the *coldness* of the *night* and *subsequent heat*;
- 6thly. That after *several successive cold days and nights*, the *sap* would rise during *the whole day*, if it chanced to be *fine*, although *slowest* at *noon*.
- 7thly. That if warm weather had made the *sap* flow *vigorously*, that *vigour* would be *abated* immediately by a cold easterly wind and a cloudy sun,

when the sap would *sink* at the rate of an inch per minute ; but when the sun shone out, and the wind shifted, it rose again as usual.

8thly. The OLDEST VINES were *soonest affected* by a *change of temperature*, and in them the sap *first* began to *sink*.

9thly. And, on the contrary, when the tube was fixed to a very short stump of a YOUNG VINE, and at only 7 inches from the ground, the sap flowed *incessantly*, and *fastest* of all, in the *greatest* heat of the day, *sinking* only after *sun-set*\*.

He then makes this *general conclusion*, that the rapidity with which the sap circulates in the vine during SPRING is *five times greater* than the rapidity with which the blood flows in the *arteries* of a *horse*, that it is *considerably slower* in the SUMMER than in spring, very *languid* in AUTUMN, and *ceases altogether* in the WINTER.

The above experiments clearly demonstrate, that it is

\* This last observation is very valuable, and exactly applies to the human frame. If a child or an old man take the strong stimulus of opium or wine, an *exhaustion* of the irritability of the fibre ensues, as is shewn in page 367 ; but if the same quantity be given to a person in the vigour of health and life, it seems to call forth the irritability of the fibre without exhausting it, and the actions of life become increased, and sleep does not take place before the customary hour. This will be further illustrated page 417 and 418, on the different Effects of the Cold Bath on strong and very weak Constitutions.

not from *heat* and *light* alone that the sap rises in the vine, for if that were the case it would *increase* as the heat increased, it would be greatest in the *noon-day* and in the *height* of *summer*, and *less* in *spring* than in *autumn*, whereas the reverse is here shewn to be the case. It must therefore depend on the IRRITABILITY of the fibre, which gets *exhausted* by the stimulus of *heat* and *light*, and is *accumulated* by its *absence*.

In the same way the IRRITABILITY of the *bedysarum gyrans* is exhausted by the heat of the noon-day sun; and, according to the experiments of FONTANA it is proved that the IRRITABILITY of the *sensitive plant* is *great* in the *morning*, *diminished* during the *heat* of the *day*, and *little* or *none* in the *evening*.

Hence it is that the return of *cold* and *frost* in the *spring* is so *noxious* to vegetables, and that this season is *forward* according to the severity of the preceding winter.

FONTANA observed, that during winter the *vipers* which he kept for his experiments were in a *torpid state*, though the thermometer was at 59 degrees. He endeavoured to render them vigorous by *warmth*, and exposed them to a heat of 67 degrees only. *In two minutes they died*, though during *summer* they bear a *much greater*



*degree of heat, without the least injury; but then they are less irritable.*

SPALANZANI observed the *newts* bury themselves in the earth, and become *torpid*, in the month of *October*, before the thermometer in the shade falls to 54 degrees; and that they *re-appear* in the month of *February*, though at that time it freezes during every night, and not unfrequently during the day the thermometer is many degrees *below* 54.

“*What is the reason,*” enquires this excellent observer, “*that these animals revive in SPRING, when the cold is more intense; and sink into torpidity at a much less degree of cold in the AUTUMN?*”

I will solve this problem, by observing that in AUTUMN a very great stimulus is required to act upon the fibre of these animals, *exhausted* as it has been by the heat of the summer; but in SPRING, the least stimulus, the least increase of heat, is sufficient to put the fibre into action, its *irritability* having *accumulated* during winter in consequence of the *absence* of the common stimuli.

Thus precisely is it with the *vegetable tribe*, for they *sleep* in winter, and are *awakened* by the vernal sun; but die, if too powerful a heat be suddenly applied.

On

On this principle we may account for the destruction of plants by *blight* in summer; for unless there be *frost* at night there is no blight; and it may be remarked, that the blight does not take place during the action of the *frost*, but at the rising of a *cloudless sun*.

Hence it is that our garden crops, such as French beans and peas, which usually suffer most by blight after a frosty night in summer, suffer no injury if they are watered immediately before the rising of the sun, because the evaporation abates the heat.

The effects of winter are therefore very great in cold climates, because the accumulation of the *irritability* is in proportion to the abstraction of the stimulus of heat.

In LAPLAND corn ripens in 60 days, whereas in FRANCE it requires 120 or 160 days. The truth of what is here advanced may be proved by exposing vegetables *alternately* to *heat* and *cold*: it is surprising how much their growth and the power of vegetation is increased. But in these experiments care must be taken to vary the temperature by degrees; because the *irritability accumulating* in the fibre by the abstraction of the heat, a very small quantity of this stimulus *then* applied is sufficient to exhaust it entirely, or to destroy it.

SECT.

## SECT. XXXVIII.

## THE MANNER IN WHICH COLDS AND INFLAMMATORY FEVERS ARE PRODUCED.

ON going into a *cold bath*, suppose at 33 degrees of heat on Fahrenheit's scale, the action of the capillary arteries of the skin is *diminished*, or ceases for a time. Hence less or no blood passes these capillaries, and paleness succeeds. But soon after emerging from the bath, a more florid colour, and a greater degree of heat, is generated on the skin than was possessed before immersion; for the capillary arteries, after their quiescent state, occasioned by the want of stimulus, become *more irritable* than usual to their natural stimuli, owing to the *accumulation* of irritability, and hence a greater quantity of blood is transmitted through them, and in consequence a greater degree of heat succeeds. Besides the *quiescence* of the minute vessels of the lungs, there are many other systems of vessels which become torpid from their irritative associations with those of the skin.

From the *quiescence* of such extensive systems of vessels as the capillaries of the skin, and the minute vessels of the lungs, with their various absorbent series, a great *accumulation of irritability* is occasioned ; part of which is again expended in the increased exertion of all these vessels, with an universal glow of heat in consequence of this exertion, and the remainder of it adds vigour to both the vital and voluntary exertions of the whole day.

If the activity of the subcutaneous vessels, and of those with which their actions are associated, was too great before cold immersion, as in the hot days of summer, by which the *irritable principle* was previously *diminished*, we see the cause why the cold bath gives such present strength ; namely, by stopping the unnecessary activity of the subcutaneous vessels, and thus preventing the too great *exhaustion* of the *irritable principle*.

In those constitutions where the degree of *inirritability*, or of debility, is greater than natural, the coldness and paleness of the skin, with the quick and weak pulse, continue a long time after the patient leaves the bath ; and the subsequent heat approaches by unequal flushings, and he feels himself disordered for many hours. Hence the bathing in a cold spring of water, where the heat is  
but

but 48 degrees of Fahrenheit's thermometer, much disagrees with those of weak or unirritable habits of body ; who possess so little of the *irritable principle*, that they cannot without injury bear to have it diminished even for a short time ; but who can nevertheless bear the more temperate coldness of Buxton baths, which is about 80 degrees of heat, and which strengthens them, and makes them by habit less liable to great *quiescence* from small variations of cold, and thence less liable to be disordered by the unavoidable accidents of life. Hence it appears, why people of these unirritable constitutions, which is another expression for a defective irritability, are often much injured by bathing in a cold spring of water ; and why they should continue but a very short time in baths which are colder than their bodies ; and should gradually increase both the degree of coldness of the water, and time of their continuance in it, if they would obtain salutary effects from cold immersions †.

One RICHARD EDWARDS, of *Liverpool*, a healthy young man, twenty-eight years of age, with black hair and a ruddy complexion, went into some fresh water, which was about the temperature of mild weather, viz. about 40 degrees by the thermometer. He continued

† Dr. DARWIN. Vide note \*, page 413.



in this water 34 minutes, and then went into a *warm bath* at 90 degrees.

Here for the first moments he felt very warm, but his hands and feet gave him pain, and in two minutes, being still in the warm bath, he was seized with *shiverings*. The water was now increased in heat 6 degrees, but our experimentalist still felt cold; the heat was further increased 10 degrees, and after remaining in the warm bath half an hour, he came out sick and very languid, his pulse was quick and feeble. He passed a very feverish night, and the next day had wandering pains over his body, with great weakness resembling the *incipient stage* of a fever.

Now it can make little difference whether a person pass from *cold air* or *cold water* into *warm air* or *warm water*; and I have often seen, says Dr. BEDDOES, persons who had long been riding in the cold and wet, experience the *first symptoms* of fever upon coming into a *warm room*, sitting *near the fire*, and *drinking spirits*. After riding in the rain until I have been thoroughly soaked, I have always experienced, says he, a glow, as if my skin had been on fire, merely from putting on dry clothes, and the exertion attending the change of dress. At the same time I have  
felt



felt within my nostrils the dryness and heat that is perceived at the beginning of a cold, which however I have escaped by keeping *cool* and *quiet* for a time. I have known this exactly to be the case with others; and I have made the observation so often, that I am certain I am right.

A patient lately mentioned to me, says this ingenious physician, among the particulars of her complaint, a circumstance which seems, both on account of its singularity, and the illustration it affords of an *important principle* in animal nature, to be worth recording. Her constitution was one of those, where a small irregularity in diet, exposure to cold, &c. produced pain and disorder in the bowels, sometimes arising to a severe fit of the colic. The patient having one day occasion to wash some butter, conceived that by removing her hands occasionally out of the *cold spring water* into *warm water*, she should have a better chance of escaping the accustomed complaint in her bowels. She accordingly heated some water as hot as she could well bear it, and from time to time transferred her arms out of the *cold* into the *hot water*, immersing them pretty deep in the latter. It was on a Saturday in spring: the next morning she was awakened by violent pain under each axilla, and  
was

was likewise sensible of a considerable swelling under each axilla. The inflammation continued, and by Tuesday morning the tumors had increased to the size of a twopenny loaf each. They soon afterwards broke, and discharged a large quantity of pus. In about a fortnight both wounds were healed. These circumstances indicate a true *phlegmonic inflammation*, which I suppose may be safely ascribed to the *alternate* action of *heat* and *cold*.

Mr. CLARKSON, in his Essay on the Impolicy of the African Slave Trade\*, informs us, that when slaves are brought on board, the seamen, to make room for them, are turned out of their apartments, and sleep for the most part on the decks, from the time of their leaving the coast of *Africa* (where the *days* are *excessively hot*, and the *dews* *excessively cold* and *heavy*) to their arrival at the *West-India islands*. From this bad lodging, he proceeds, and this continual exposure to *colds* and *damps*, and *suddenly* afterwards to a burning *sun*, *FEVERS* originate, which carry many of them off! This fever attacks the whole frame: but the eye commonly feels the inflammation most. The inflammation of the eyes ter-

\* Vide Part I. page 54, 55, and 56.

minates either in dispersion or suppuration : in the first instance the eyes are saved ; in the latter they are lost.

The inflammation of the eye is not the only disease produced in EGYPT by the succession of *hot days* to *cool nights*, where it is the custom to sleep during the summer in the open air, any more than on board our slave ships ; as the reader will find upon recurring to Alpinus and the later travellers. In both situations causes and effects run parallel. The well known danger of exposure to *dews* in *hot climates*, and indeed in all climates, in certain cases, seems to depend on the same principle. It is also probable that the *heat* of the *preceding day* enables the *dews* of the *night* to prepare the system for the *stimulating effects* of the *heat* of the *succeeding day* ; so that of two persons who should expose themselves without precaution to the *cold* of the *night* and the *heat* of the *following day*, he who should have been most *exhausted* the day before by the *heat*, would, if other circumstances could be rendered alike equal, be most injured by the next alternation.

Thus when any part of the body has been exposed to *cold*, it is liable to be much more affected by heat and other stimuli than before the exposure. Of this the method of treating *frozen limbs* in cold countries affords a beautiful

ful and decisive proof. Were a frozen limb to be brought before a fire, or immersed in warm water, a violent inflammation would come on, and speedily terminate in mortification. They therefore take *snow* to rub the parts benumbed with cold, and very gradually expose them to a warm temperature. This custom universally obtains in all the northern climates, where the rude inhabitants possess a method of relief that might do credit to the ingenuity of more enlightened nations, and such as is not unworthy of their imitation! The pungent pain felt upon holding an hand much chilled to the fire, is another exemplification of the same principle, which seems, says Dr. BEDDOES, to be one of the most general laws of animal nature.

Now after the application of cold, which, according to circumstances, produces a greater or smaller diminution of the actions of the living system, and at length sleep itself, there may be an infinite number of gradations between a *fatal inflammation* and a *transitory glow*, and this according as the previous cold and the subsequent heat have varied in intensity;—but whatever be the degree, the effect depends on the same principle\*.

By respiring a *cold atmosphere* the same thing happens to the nostrils, fauces, lungs, as to the external surface

\* Dr. BEDDOES.

of the body upon going into a *cold bath*; and if we pass suddenly from *such an atmosphere* into a *warm room*, what happens to the skin will in some degree happen to the membrane lining these cavities; a *glow* or *inflammation* will ensue, according to the difference between the two temperatures and the length of time passed in the cold.

When the application of cold or moisture to a superficial part only is succeeded by an *inflammation* of the respiratory cavities, the consent of the whole system easily explains this remote local affection. The cause of disease pervades at once, and feels as it were, or searches the whole body, but affects only in a degree to draw our notice to the organ which from habit or structure is *most tender*. Should any other part, from previous circumstances, have been rendered more sensible to its influence, we shall in consequence have either a sore throat, a diarrhœa, a stiff neck, or the rheumatism, in place of a catarrh.

CHILDREN are so susceptible of *inflammation* that a great part of the mortality among them is, as far as I have observed and can judge, to be ascribed to the ignorance of mothers and nurses of the power which even a moderate change of temperature, if suddenly made, has to effect their tender and irritable frame.



<i>Names of the Parents.</i>	<i>L.</i>	<i>D.</i>	<i>Names of the Parents.</i>	<i>L.</i>	<i>D.</i>
Marg. Jones - - - -	6	3	Samuel Holyhead - -	4	8
Mary Holmes - - - -	4	0	George Highwey - -	8	0
Thomas Sanford - - -	7	4	Constant Richards - -	3	0
John Smouch - - - -	6	6	Mary Walker - - -	3	0
Anne Roberts - - - -	3	0	Edward Evans - - -	3	4
E. Felton - - - - -	7	6	Anne Hughes - - -	4	2
E. Jinks - - - - -	1	6	Jane Ingram - - -	3	1
R. Richards - - - -	1	0	John Hammond - - -	4	2
Robert Pigging - - -	7	1	Elizabeth Smith - -	3	4
E. Ward - - - - -	3	2	Mary Richards - - -	2	1
Sarah Colley - - - -	4	1	Sarah Richards - - -	6	0
Lucy Clark - - - -	3	6	Catherine Harper - -	5	0
Elizabeth Higenfon - -	4	4	Anne Hutchenfon - -	4	3
Joseph Sonds - - - -	3	1	Philip Saunders - -	4	0
John Holyhead - - - -	4	3	Elizabeth Heath - -	7	1
Thomas Felton - - - -	7	2	Mary Ames - - -	7	1
Anne Williams - - - -	7	1	Mary Bagnold - - -	4	0
John Smith - - - - -	5	2	Elizabeth Mansfield -	8	1
Joseph Hutchenfon - -	4	0	Elizabeth Evans - -	4	0
J. Ellis - - - - -	3	3	Anne Horton - - -	3	0
Elizabeth Poignnor - -	3	1	Thomas Ingram - - -	3	0
Anne Withington - - -	6	4	Joseph Ingram - - -	3	0
Jane Underwood - - -	5	2	Jane Swanwick - - -	5	2
Jane Fields - - - -	3	2	John Beeston - - -	4	1
James Ingram - - - -	2	2	John Bostick - - -	5	0
John Askey - - - - -	5	0	Joseph Heans - - -	6	3
John Smith - - - - -	2	0			
E. Horton - - - - -	7	0			
E. Hollinhead - - - -	3	5	55	*Total -	224 99

\* This enquiry was made by Dr. BEDDOES, at *Shifnal* in *Shropshire*, where firing is very plentiful and cheap. It was asked of each grown up person there, how many children he had had, and how many were dead? In the first column you have the name of the family; in the next the number of the children alive; and the third the number of the children dead. Whenever accurate registers of the mortality of the human species, in climates equally warm, shall be kept, I expect that not half so many infants will be found to die as in GREAT BRITAIN.

Now



Now which, think you, is the most likely, that there should be something *wrong* in *our management*? or that *three parts* in *four* of our fellow creatures should, in one of the most airy towns in GREAT BRITAIN, be doomed unavoidably to perish before they come to their full growth, without answering any other purpose than to give trouble and endure pain? If this last be the case, then of all the things in this wide world, the human frame is the worst contrived and executed. And I leave you to judge whether such a supposition stands to reason. If then *our management* of our *children* be *wrong* in any material points, a stop may be put to this *excessive mortality*, for we should have only to find out what these points are, and shape our conduct accordingly. One may with the greater propriety embrace an opportunity of disseminating the knowledge, “how COLDS, FEVERS, and RHEUMATISMS, are caught,” as their remote and proximate causes, and the manner in which they are to be got rid of, though in my opinion perfectly ascertained, is far from being generally understood even by the members of the medical profession; and if any person, not belonging to that profession, should suspect this to be a wanton paradoxical assertion, he may find in the case of *opium*, and of the cool treatment of *small-*

*pox*, &c. instances equally striking, where one generation of pathologists passed away after another, without being able, in the case of *opium* \*, to perceive the *plainest appearances*, or, in that of *small-pox*, to draw *the simplest conclusion*. So fervently imitative an animal is man! So loath to employ his own powers of perception and thought!

THE sudden, and sometimes severe, changes of weather to which this climate is subject, are perhaps the most unhappy circumstances attending our situation; and the pernicious effects of them upon the human constitution are so frequently experienced, that diseases of the breast may be truly considered as endemical among the inhabitants of this island. We frequently find a *cold* and *keen* day succeeded by one as *mild* as spring or *warm* as summer; or, what is still worse, the forenoon accompanied with a *sharp, dry, biting north-east wind*, and the latter part of the day uncommonly *warm*. It is impossible but this sudden change from *cold* to *heat* must, in

\* One cannot compare HALLER's clear and satisfactory parallel of *wine* and *opium*, published in 1769 (El. Physiolog. t. V. p. 610—11.) with CULLEN's perplexed and hypothetical doctrine of *opium*, and his whole article *sedentia*, published in 1789 (Mat. Medica, t. ii. 217, *et seq.*) without a sense of humiliation!—Dr. BEDDOES.

delicate constitutions especially, be productive of mischief.

When alterations of weather from *cold* to *heat* succeed gradually, those salutary powers of accommodation with which the animal œconomy is furnished, may prevent any mischief or disorders, though an alteration in the constitution proportioned to that in external nature must necessarily succeed those changes; but that which might, without inconvenience to the constitution, be produced *gradually*, will, if *too sudden* and *abrupt*, be felt as a disease; as a man may with ease and safety gradually descend a flight of steps, when a sudden jump from them would endanger his life. Thus we bear without injury the *heat* of *spring* after the *coldest winter*, though it must be confessed that disorders take on at that season a more inflammatory appearance.

But where the change is more violent than in the transition from one season to another, as when *Europeans* go to the *East* or *West Indies*, until the constitution becomes accommodated to the climate, the *uncommon heat* to which such persons are exposed, must have a most powerful effect on their irritable frames. Immediately on the arrival of *northern strangers* within the *tropics*, their circulation becomes quicker, their perspiration

tion freer; a lassitude or debility takes place, from the uncommon expence of the irritable principle consumed by the increased actions of the heart and arteries, and the secretions dependant in a great measure on their movements. In short, the pulse is rendered harder, fuller, and stronger. The skin is redder than usual, but especially that of the face, with other signs of general plethora \*, to which the fluids from increased absorption certainly contribute, though it chiefly arises from the increased force of the vascular system. In short, more or less of *fever* is kept up, which varies in different people, according to circumstances, continues for an indeterminate time, or until the increased force of the heart and arteries, kept up by the *accumulated irritability* of the system, from the previous effect of *cold*, ceases, that is, until the right balance between the irritability of the fibre and the external stimulus be properly adjusted.

\* HEAT has the property of *expanding* all bodies: thus a circular piece of iron made exactly to pass through a ring, when heated, will be found too large, and thus the rings on the fingers of those who have passed into warmer climates, will be found, from the increased size of that part of the *body*, too tight. In the *cold fit* of an ague rings are observed to drop off. But the PLETHORA here spoken of arises from the increased action of the *absorbent*, as well as the *vascular system*.

But if, on the contrary, we pass from a *warm* to a *cold* climate no such evil effects are observed to take place. LINNÆUS, in a paper in the *Amœnitates Academicæ*, expresses his astonishment at the impunity with which the *heated* LAPLANDER rubs himself with *snow*, or even rolls in the *snow*, and drinks the *cold snow water*. We every day see *horses* in a state of the *most profuse perspiration* freely washed with *cold water*, and always *without injury*. I have, says Dr. BEDDOES, within these two years caused horses, accustomed to be stabled, to be turned out in winter; and no cough, catarrh, or other disorder, has ever been the consequence. It appears therefore to me, continues this ingenious physician, that within certain limits, and those not very narrow, the transition from a *higher* to a *lower temperature* is attended with *no danger* to animals in a state of tolerable health; and a person, I conceive, might *suddenly pass* from an *higher* to a *lower temperature* without *inconvenience*, even where the difference is so great as to be capable of producing *considerable inflammation*, if the change should be made with equal celerity in a contrary direction.

It has been before observed, that if you keep *one* of your hands in *cold water* for two minutes; then put *both hands* into *warm water*; and *the hand* which has been in the



the *cold water* first will feel much the *warmer* of the *two*. Or else, handle some *snow* with *one hand*, while you keep *the other* in your *bosom*, that it may be no colder than the rest of your body; now bring *both* within an *equal distance* of the *fire*, and you will feel *how much more* THE HEAT affects the *cold* than the *warm hand*. This would be a *dangerous experiment* were the hand kept *too long* in the *snow*, or if *the fire* be *too strong*. For in some countries where the *cold* is much greater than it ever is in ENGLAND, it is common for people to have their toes and fingers and ears so *frost-bitten* as to lose all their feeling; and should that person *warm* them at a fire, or put them into *warm water*, a VIOLENT INFLAMMATION is sure to come on, and the part *mortifies*. So they are obliged to set cautiously about bringing the part back to its natural feeling, and they rub it hard with *snow*, by which means they recover it in the gentlest and most gradual manner\*.

So when a person is out in very *cold weather*, the air, every time he draws his breath, brushes his *nostrils*, *wind-pipe*, and *lungs*; and just as is the case with the *outward skin*, it makes *these parts* more liable to be INFLAMED by HEAT.

\* Vide page 422.



If you attend to what not unfrequently happens in coming out of a *cold moist air* into a *warm room*, you will first perceive a *glow* within your nostrils and breast, as well as all over the surface of your body. Soon afterwards, more especially, if you drink warm or spirituous liquors, a disagreeable dryness, or huskiness, will be felt in the nostrils and breast; by and bye a short tickling cough will come on from an increased secretion of the glands of the nose, fauces, and wind-pipe, which being of a sharp nature stimulates the glands to a further increase of secretion, which often occasions a very large discharge of sharp mucus. You will perhaps at first shiver a little; this will make you draw nearer the fire and drink some more brandy and water: but it will be all to no purpose. The more you try to *heat yourself*, the more chilly and uncomfortable will you become, for you have now *caught cold*, that is, you have *brought on* AN INFLAMMATION of *the chilled part*, which is the smooth moist skin which lines the nostrils and goes down the wind-pipe into the lungs, and I wish you, with all my heart, well rid of it, and safe from the complaints which severe colds are apt to leave behind them.

I have sometimes been able to make other persons, says Dr. BEDDOES, attentive to the progress of these phenomena,

phenomena, and nothing has appeared more evident, than that during exposure to *wet* and *cold* no tendency to INFLAMMATION is perceptible, but that *subsequent heat*, *exercise* in the dry, and *stimulants*, produce the *glow* or INFLAMMATION.

By keeping *quiet* and *cool* for some time after being *wet* in summer, and by avoiding a *sudden transition* into a *warm temperature* in *cold weather*, and by *temperance* with regard to diet (rather *abstemiousness*), in *both cases* those INFLAMMATORY DISEASES, for which *cold* only *prepares the system*, may be easily avoided; and any person, by acting upon these *principles*, may have at pleasure a *slight* or a *violent catarrh*, or *no catarrh at all*\*.

\* The *popular treatment*, therefore, of *colds* during their early stage is just as prejudicial as the ancient *hot regimen* during the SMALL-POX. White wine whey, buttered ale, increased clothing, getting drunk, &c. originated from the supposition, that *colds* proceed from *obstructed perspiration*, whereas it is found from the very accurate experiments of SANCTORIUS, and our countryman Dr. KEIL, that the *perspiration* is at that time as *abundant* as at any other. It has continued, because the faculty were, till of late, unapprized of the nature of *colds*, and from partial success in this dangerous practice, as *perspiration*, when produced, carries off *superabundant heat*. For the fluid that escapes from the body consists chiefly of watery moisture, which uniting with a large portion of sensible heat, is carried off in the form of steam. Hence the more speedy the evaporation, the more sudden is the diminution of heat; or, in more familiar terms, the greater is the degree of cold thus generated. Hence the *heaping on* of STIMULI in a disease demanding an *opposite treatment*, has oftentimes done good, but it is to be feared, it has not unfrequently done harm, whereas the treatment here laid down is both *safe* and *effectual*. Vide Part IV. The Section on CATARRH.

SECT.

## SECT. XXXIX.

## OF DARKNESS..

As a due degree of stimuli is necessary to the maintenance of firm health, we now see the reason why confinement in dungeons, independent of dampness, is so injurious to the health of prisoners: and why the meaner sort of houses in this country, since they have been *darkened*\* in consequence of the heavy window tax, have been observed to exhibit a race of more pale and sickly inhabitants. Finally, why the *gloomy chambers* of the sick, labouring under asthenic diseases, are rendered more unwholesome, and acquire additional horrors, by indiscriminately shutting out the cheerful beams of day: and why the effects of all diseases of this class are in-

\* The fact was repeatedly noticed in his different journeys by the philanthropic Mr. HOWARD; and it is notorious to every eye, that the servants who are stewed in dark chambers deprived of *fresh air* and the *morning light*, exhibit the most sickly appearance. It requires another HOWARD to point out the *evils* inflicted by the *governors* on the *governed*, and to stir up HUMANITY in the cause of *suffering Nature*; and, since even a *bad government* is, comparatively speaking, a  *blessing*, to occasion it to be *so administered* as to make it the FIRST OF BLESSINGS.

creased by thus imprudently depriving the patient of one of the most exhilarating cordials in nature.

“ That the *absence* of LIGHT *accumulates* IRRITABILITY in the fibre,” is shewn from the following experiment.

I enveloped, says GIRTANNER, the leaves of the *mimosa*, or sensitive plant, in an opaque body, so that the air might have free access, while the light could not penetrate, and I found that all these leaves became *considerably more irritable* than the rest.

Animals deprived of LIGHT, or living in DARK PLACES, lose their colour and become *white*, as is observable in *arctic animals* during the long nights in the countries near the pole: I have observed it also in the animals that inhabit the *Alps*, and which conceal themselves the greatest part of the year in subterraneous dwellings. Mice kept in a cage in a very dark room produce *white mice*.

If we consider the complexion of different countries, we shall find them dark in proportion to the nature of the climate. In general it may be asserted, that, as we approach the line, we find the inhabitants of each country grow browner until the colour deepens into perfect blackness.

blackness. All EUROPE, almost the whole of ASIA, and the temperate parts of AFRICA, are occupied by men of a fair complexion. All the torrid zone in AFRICA, some of the warmer regions adjacent to it, and a few countries in ASIA, are filled with people of a deep black colour. If we trace the nations of our continent, making our progress from cold and temperate countries towards those parts which are exposed to the influence of vehement and unremitting heats, we shall find the extreme whiteness of their skin soon diminish, and its colour deepen gradually as we advance; and, after passing through all the successive gradations of shade, terminate in an uniform unvarying black. Thus, taking our standard from our own country, we find the FRENCH, who are more southern, a slight shade deeper than *we*; going further down, the SPANIARDS are browner than the *French*; the inhabitants of *Fez* darker than *they*; and the natives of NEGROLAND the darkest of all. The *irritable principle* in the fibre is also found to correspond with *these shades*.

In all regions the *children* are born *fair*, or at least *red*, and grow darker or black as they advance in life. The *soft flaxen hair* inclining to *red*, and the *blue eye*,  
denotes

denotes an IRRITABILITY of *temperament*, whereas the *curled black* and *strong hair*, with a *black eye*, shews a stronger fibre, with LESS IRRITABILITY.

*Blanched* plants lose their green colour and become white, and are not then capable of supporting a great quantity of LIGHT. In the *white Negro*, born of black parents, exhibited in LONDON, the hair was of a *silver white*; the eye had a ferrety appearance, and was so *impatient* of the *stimulus* of LIGHT, that it was almost in constant action. These accidental varieties in the human species are properly called MOON-EYED, for they cannot endure the glare of light from the sun, and though they enjoy his reflected rays from the moon, they are not able to behold that luminary. The nose in this *white negro* was flat, exactly resembling that of a black, and the lips were thick, and the skull prominent from behind. No doubt, therefore, remained of this woman having been born of negro parents\*; and the person who shewed

\* She was at this time giving suck to an infant whose father was a white, but the child had all the appearance of a *mulatto*.

There is now at EXETER CHANGE a man, born of black parents, who is black and white, directly *pie-balled*.

1st. *Query*. Would the TRADERS IN HUMAN FLESH feel some conscience in selling this *white negro* woman?

2d. *Query*. On which side would the balance of opinion preponderate with them with regard to the *pie-balled* man?



it had attestations to convince the most incredulous. This variety of the human species has been particularly observed in three different districts of America. Their skin is covered with a fine hairy down of a *chalky white*, the hair of their heads, their eye-brows, and eye-lashes, are of the same hue. They are universally described by all travellers as a race of *low STATURE*, of a *feeble MAKE*, and *incapable of enduring the slightest FATIGUE*\*.

It is melancholy to observe the pains some white men have been at to represent the *black race* as a lower species of animal, to confound them with the monkey; or if men, to degrade them into beings destined by a benevolent and superintending PROVIDENCE to become the *slaves* of such as boast the names of *Christian* and *European*!

If they are uncivilized, it is you who have plunged them deeper in their darkness. If their country is unfruitful, it was once the chief resource of Rome. If barbarous in the extreme, you have set them a still more barbarous example. And if it shall be said, that the 18th century was an enlightened period, your deeds will be adduced to disprove the assertion. Vide Part I. page 54; also note †, page 56.

\* See ROBERTSON'S History of America.

## SECT. XL.

## OF SLEEP.

THOUGH man in his sleeping state is a much less perfect animal than in his waking hours, and though he consumes more than one third of his life in this his irrational situation, yet is the wisdom of the AUTHOR of NATURE manifest even in this seeming imperfection of his work.

According to Dr. JOHN BROWN,

- I. *Life is a forced state.*
- II. *To every animated being is allotted a certain portion of the IRRITABLE PRINCIPLE \*.*
- III. *Every power that acts on the living frame is STIMULANT, or produces excitement by expending IRRITABILITY.*

\* Dr. BROWN supposed every living system to have received at the beginning its *determinate portion* of IRRITABILITY, and therefore, although he spoke of the *exhaustion, augmentation, and even renewal*, of IRRITABILITY, it was not his intention to induce his pupils to think of it, as a kind of FLUID SUBSTANCE generated in the animal body. According to him IRRITABILITY was an unknown *somewhat*, subject to *peculiar laws*, and whose *different states* we were obliged to describe by terms borrowed from the qualities of material substances. See Part I. page 33; also the Life of Dr. BROWN by Dr. BEDDOES, prefixed to a new edition of his works.

IV. The EXCITING POWERS may be referred to 2 *classes*.

1. *Mechanical*, as heat, food, blood, &c.
2. *Mental*, as thought, and the emotions of the mind, &c\*.

V. The application of *stimuli* † after a certain time *exhausts* the IRRITABILITY, or EXCITABILITY, of the system.

To *recruit which loss*, the all-wise and merciful CREATOR has instituted the season of SLEEP, at which time the sti-

\* As Dr. BROWN has defined *life* to be a *forced state*, it is fitly represented by a *flame*, forcibly drawn forth, from *fuel little disposed to combustion*, by the constant application of streams of *air* poured into it from the different tubes of a machine.

1. If some of the tubes are supposed to convey *oxygen*, or *pure air*, they will denote the highest class of exciting powers, *opium*, *musk*, *spirits*, *camphor*, *wine*, &c. the DIFFUSIBLE STIMULI of Dr. BROWN, which bring forth for a time a greater quantity of life than usual, as the blowing in of *pure air* into a fire will temporarily draw forth an uncommon quantity of flame.

2. If other tubes be supposed to convey *common*, or *atmospheric air*, they will represent the ordinary EXCITING POWERS, or stimuli, applied to the human frame, such as *heat*, *light*, *air*, *food*, *drink*, &c.

3. While such as convey *impure* or *bad air* may be used to denote what have formerly been termed SEDATIVE POWERS, such as *bad diet*, *contagious miasmata*, *foul air*, &c.

† The reader will now probably be at no loss to understand the seeming paradox of the *Brunonian system*; that food, drink, and all the powers applied to the body, though they *support life*, yet *consume it*; for he will see, that the application of these powers, though they *bring forth life*, it wastes the EXCITABILITY, or MATTER OF LIFE, just as the air blown into the fire *brings forth more flame*, but *wastes THE FUEL*, or MATTER OF FIRE. This is conformable to the common saying, the more a spark is blown, the brighter it burns and the sooner it is spent.

muli of external objects are excluded by the *silence* and the *darkness* of the night; and as *cold* \* accumulates the irritability of the fibre, it is wisely fore-ordained that this season shall be accompanied with a suitable degree of *cold*. Common or ordinary sleep, produced by the application and action of stimuli, from what has been said, seems therefore to be a state, the result of a law of the animal œconomy, which takes place in order to remove the effects of stimuli, and to *restore*, as much as possible, the *excitability* of the system; as during this state the stimulus of volition is suspended, all external objects cease to make impression, even cathartics lose their powers of action, while the *atmosphæric air* is almost the only external power, which then continues to be applied, at once carrying off what is excrementitious from the lungs, as it affords probably to the system that *principle* which is expended by the various actions of life.

Besides the very great quantity of the IRRITABLE PRINCIPLE perpetually *expended* in moving the arterial, venous, and absorbent systems, and the other organs of the body, as described page 351, there is also, during our waking hours, a *constant expenditure* of it by the action

\* Hence the evil of *feather-beds*; for we should court no more than a *suitable degree of warmth*.

of our locomotive muscles and organs of sense. Thus the optic nerves, where they enter the eye, and the great expansion of the nerves of touch beneath the whole of the cuticle, evince the *great consumption* of the IRRITABLE PRINCIPLE by these senses. And our perpetual muscular action in the common offices of life, and in constantly preserving the perpendicularity\* of our bodies during

\* When any person loses the power of muscular action, whether he is erect or in a sitting posture, he sinks down upon the ground; as is seen in fainting fits, and other instances of great debility. Hence it follows, that *some exertion* of muscular power is necessary to preserve our *perpendicular attitude*. This is performed by proportionally exerting the antagonist muscles of the trunk, neck, and limbs; and if at any time in our locomotions we find ourselves inclining to one side, we either restore our *equilibrium* by the efforts of the muscles on the other side, or by moving one of our feet extend the base which we rest upon to the new center of gravity. But the most easy and habitual manner of determining our want of perpendicularity, is by attending to the *apparent motion* of the objects within the sphere of distinct vision. Hence no one who is hood-winked can walk in a straight line for a hundred steps together; for he inclines so greatly, before he is warned of his want of perpendicularity, not having the apparent motions of ambient objects to measure this inclination by, that he is necessitated to move one of his feet outwards, to the right or to the left, to support the new centre of gravity, and thus errs from the line he endeavours to proceed in. Thus any one who stands alone on the top of a high tower, if he has not been accustomed to balance himself by objects placed at such distances and with such inclinations, begins to, and endeavours to recover himself. During this time the apparent motion of objects at a distance below him is very great, and the impressions of these apparent motions continue a little time after he has experienced them; and he is persuaded to incline the contrary way to counteract their effects; and either immediately falls, or applying his hands to the building, uses them to preserve his

during the day, evince a considerable *expenditure* of the IRRITABLE PRINCIPLE by our locomotive muscles. It follows, therefore, that if the exertion of these organs of sense and muscles be for a while *intermitted*, that a *large quantity* of the IRRITABLE PRINCIPLE must be *accumulated*.

As soon as a person begins to sleep, as (in *hemiplegia*, where the *limbs* on *one side* have lost their power of voluntary motion, and the patient is for many days employed in moving those of the *other*, or as when in the *cold fit* of an intermittent fever some parts of the system have for a time continued *torpid*, and have thus expended less than their usual expenditure of the IRRITABLE PRINCIPLE), a *hot fit* succeeds; so, owing to *the suspension* of the voluntary actions, the peristaltic motion of the

his perpendicular attitude, contrary to the erroneous persuasions of his eyes. Thus on horseback we accurately observe another person, whom we meet trotting towards us, without confounding his jumping and progressive motion with our own, because we have been accustomed to them both; that is, to undergo the one, and to see the other at the same time. But in riding over a broad and fluctuating stream, though we are well experienced in the motions of our horse, we are liable to become dizzy from our inexperience in that of the water. And when we first go on ship-board, where the movements of ourselves, and the movements of the large waves are both new to us, the *vertigo* is almost unavoidable with the terrible sickness which attends it, and after we come from on ship-board, being used to reel about to maintain our perpendicularity, we have at first the same drunken gait as we had on ship-board.—Dr. DARWIN.

intestines,



intestines, and the exclusion of the strong stimulus of mental exertion, an *accumulation* of the IRRITABLE PRINCIPLE takes place during sleep, and the blood-vessels and absorbents have in consequence an increased action, and hence the nutriment is with great energy forced over every part of the system to repair the wastes of the preceding day: for it is probable that *nutrition* is almost entirely performed in SLEEP; and that young animals grow more at this time than in their waking hours, as young plants have long since been observed to grow more in the night, which is generally their time of sleep. Hence also the *heat* of the system is gradually increased, and the extremities of feeble people, which had been cold during the day, become warm, while in others sweats are so liable to break out towards morning\*.

\* Dr DARWIN.

SECT.

## SECT. XLI.

## SOME PRACTICAL OBSERVATIONS.

FROM the *foregoing Section* we learnt, that *night* is the time adapted for *sleep*; and from the *Section on Habit* \*, the propriety of going to bed and rising at a certain hour.

We have seen how this state is produced by the proper application of stimulant powers during the day, and since it is to accumulate irritability in the system, the chambers in which we sleep ought therefore to be *silent, dark, and moderately cold*, and since the *chief refreshment* of *sleep* arises from the *oxygen, or vital, air*, imbibed by the system, forming a part of *the digestive process* then going on, we should be *cautious* how we are *surrounded by curtains*.

In the state of nature, when the sense of hunger is appeased by the stimulus of agreeable food, and the business of the day is over, the human savage, at peace with the world, then exerts little attention to external objects;

\* Vide page 500.

pleasing reveries of his successes in hunting succeed, and at length sleep is the result: till the system is recruited, and he awakes with fresh vigour.

In like manner the poor sleep little; forced, by their situation, to lengthen out their labour to their necessities, they however go to bed early in the evening, the irritable principle being exhausted by the labours of the preceding day, and they get up refreshed at sun-rise, and accumulate again fresh irritability by the coolness of the morning\*. The blooming complexion of our peasantry, the permanence of their good looks, and their strength and activity, compared with the sickly visage and ailing constitutions of the Sons of Luxury, who turn night into day, and sleep in beds of down, clearly demonstrate which mode of life is most conducive to health.

It is justly said by Dr. MACKENZIE, that he who sleeps long in the morning, and sits up late at night, hurts his constitution without *gaining time*; and he who will do it merely in compliance with the fashion, ought not to repine at a *fashionable state of bad health*.

\* Even Dr. CULLEN, in his last work, expresses himself with a precision that is not frequently found in his theoretical writings. *A state of sleep*, says he, *subsisting for some time, induces a state of the system more ready to be affected by stimuli of all kinds.* *Materia Medica*, II. 223.

*Sleep*, tired Nature's sweet restorer, cannot be safely dispensed with. *Study*, protracted far into the hours of night, *cares harboured*, and even very *late hours* in company, by encroaching on the hours adapted for sleep, are sure to lay the foundation of many dreadful diseases.

If *sleep* does not pay the accustomed visit, the whole frame of man will in a short time be thrown into disorder; his appetite ceases; his spirits are dejected; and his mind, abridged of its slumbering visions, begins to adopt waking dreams. A thousand strange phantoms arise, which come and go without his will: these, which are transient in the beginning, at last take firm possession of the mind, which yields to their dominion, and, after a long struggle, runs into confirmed madness or death. But it is happy for mankind, that this state of inquietude is seldom driven to an extreme. However man finds it more difficult to procure sleep than any other animal, and some are obliged to court its approaches for several hours together, before they incline to rest. It is in vain that all light is excluded; that all sounds are removed; that books of entertainment are read; the *restless* and *busy mind* still retains its former activity; and reason that wishes to lay down the reins,

in spite of herself, is obliged to maintain them. This is strongly instanced by Shakespeare in the soliloquy of King HENRY.

How many thousand of my poorest subjects  
are at this hour asleep !—O ! gentle sleep,  
nature's soft nurse, how have I frighted thee,  
that thou no more wilt weigh my eye-lids down,  
and steep my senses in forgetfulness ?  
Why, rather, sleep, ly'st thou in smoaky cribs,  
upon uneasy pallets stretching thee,  
and hush'd with buzzing night-flies to thy slumber ;  
than in the perfum'd chambers of the great,  
under the canopies of costly state,  
and lull'd with sounds of sweetest melody ?  
O thou dull god, why ly'st thou with the vile,  
in loathsome beds ; and leav'st the kingly couch ?—  
A watch-case to a common larum bell !

Wilt thou upon the high and giddy mast  
seal up the ship-boy's eyes, and rock his brains  
in cradle of the rude imperious surge ;  
and in the visitation of the winds,  
who take the ruffian billows by the top,  
curling their monstrous heads, and hanging them  
with deaf'ning clamours in the slippery shrouds,  
that with a hurly, death itself awakes ?  
Can'st thou, O partial sleep ! give thy repose  
to the wet sea-boy in an hour so rude ;  
and, in the calmest and stillest night,  
with all appliances and means to boot,  
deny it to a *king*.—Then happy are *the low*, they lie down,  
uneasy is the head that wears a crown.

It is even thought unnatural for a *King* to enjoy a whole night's rest.

Now pleasing sleep had seal'd each mortal eye,  
stretch'd in the tents the Grecian leaders lie,  
th' Immortals slumber'd on their thrones above ;  
all, but the *ever-wakeful eyes* of Jove.

'To honour THETIS' son, he bends his care,  
and plunge the *Greeks* in all the woes of war :

Then bids an empty phantom rise to fight,  
and thus commands the vision of the night.

Fly hence, deluding dream ! and light as air,  
to AGAMEMNON's ample tent repair.

Bid him in arms draw forth th' embattel'd train,  
lead all his *Grecians* to the dusty plain.

Swift as the word the vain illusion fled,  
descends, and hovers o'er ATKINES' head ;  
cloth'd in the figure of the *Pylian sage*,  
renown'd for wisdom, and rever'd for age ;  
around his temples spreads his golden wing,  
and thus the flatt'ring dream deceives the king.

Canst *thou*, with all a monarch's cares oppress'd,  
Oh ATREUS' son ! can'st *thou* indulge thy rest ?

Ill fits a chief who mighty nations guides,  
directs in council, and in war presides,  
to whom its safety a whole people owes,  
to waste long nights in indolent repose.

*Monarch, awake ! 'tis Jove's command I bear,*  
*thou, and thy glory, claim his heav'nly care.*

In just array draw forth th' embattel'd train,  
lead all thy *Grecians* to the dusty plain ;

&c.————

The phantom said ; then vanish'd from his sight,  
resolves to air, and mixes with the night.



In the case of Lord LYTTLETON\*, the *want of sleep* is attributed as the cause of his death. *Intense thought* puts the brain into a state more or less unapt for rest, and a multitude of facts, in the ingenious tract of TISSOT on the Diseases of *Literary Characters*, prove, that the aptitude of the brain, to restore by sleep, the impaired energies of the corporeal functions, may be lost altogether. Much it imports, therefore, the *studious*, to limit their learned labours to proper hours, to support strength by intervals of exercise in the open air, and to *all others* to solicit sleep by a seasonable dismissal of business and of care.

\* Dr. JOHNSON says of this nobleman, that he was “Inter doctos nobilissimus: inter nobiles doctissimus, inter utrosque optimus: ut enim antiquam generis claritatem eruditione.—Eruditionem, miro vitæ candore decoravit; sic his omnibus, omnium pulcherrimam apinem, et colophocem addidit, admirabilem animi modestiam!” *Vide* Disquisitions relative to the Nervous System, p. 224.

## SECT. XLII.

## OF IMPURE AIR.

As the *immediate cause* of sleep consists in the *suspension of volition*, it follows, that whatever *diminishes* the general quantity of the *irritable principle*, or *diverts it* from the faculty of *volition*, will constitute a *remote cause* of sleep;—such as fatigue from muscular or mental exertion, which diminishes the general quantity of the *irritable principle*,—or by increasing of the action of the vascular and absorbent systems, as are the effects of opium, wine, food, &c. which not only by their expenditure of the *irritable principle* diminish the quantity of volition, but also by their producing pleasurable sensations \* (which occasion other muscular and sensual motions in consequence) doubly decrease the voluntary power, and thus more forcibly produce sleep:—or lastly, an increase of the sensitive motions, as by attend-

\* Vide page 212.

ing to soft music \*, which diverts the *irritable principle* from the faculty of volition.

*Another method* of inducing sleep, says the illustrious Dr. DARWIN, is delivered in a very ingenious work lately published by Dr. BEDDOES, who, after lamenting that *opium* frequently occasions restlessness, thinks, “ that in most cases it would be better to induce *sleep* by the *abstraction* of *stimuli*, than by *exhausting* the *excitability* ;” and adds, “ upon this principle we could not have a better soporific than an atmosphere with a diminished proportion of oxygen, or vital air, and that common air might be admitted after the patient was asleep.”

In a subsequent work, this ingenious physician says, I had formerly been led to infer, “ *that an atmosphere, with a diminished proportion of oxygen, would be in some cases a better soporific than any we at present possess, and* “ I have since † received *confirmation of this opinion.*”

A person

\* BOERHAAVE on some occasions, in order to procure sleep for his patient, directed water to be placed in such a situation so as continually to drop on a brass pan.

Fontesque lymphis obstrepunt manantibus,  
*sonnos* quod invitet *leves*.——HOR.

† Vide Considerations on the *Medicinal Use* of FACTITIOUS AIRS, to which are added *communications* from Doctors DARWIN of Derby, WITHER-

ING

A person in a consumption, who for months had taken *opium* at night, slept perfectly well *without opium* when he came to respire HYDROGEN GAS\*; his sleep he remarked to be more profound than usual. The air of his room being loosely mixed with HYDROGEN GAS, his servant, a *very bad sleeper*, declared *that he did not know what was come to him, he slept so sound*. This man necessarily inspired much HYDROGEN GAS from attend-

ING of *Birmingham*, PERCIVAL of *Manchester*, EWART of *Bath*, THORNTON of *London*, JOHNSON of *Worcester*, GARNET of *Harrowgate*, PEARSON of *Birmingham*, FERRIAR of *Manchester*, TROTTER from on board Lord Howe's fleet, to which he is physician, CARMICHAEL of *Birmingham*, BRIGGS of the island *Santa Cruz*, GIMBERNAT *surgeon to the king of Spain*, the Rev. Mr. TOWNSEND rector of *Pewsey*, the Rev. Mr. ATWOOD rector of *Saxlingham and Sharrington*, Messrs. HILL, PARR, CAPPER, SANDFORD, CHISHOLM, and others.

This long enumeration of names is given here to shew that the design of making the NEW CHEMISTRY subservient to mankind is not an *idle and ridiculous speculation*, otherwise would such a number, and of such men, for the most part unconnected but from literary intercourse, combine in recommending and trying the new remedies which it has suggested?

Dr. CRAWFORD, physician to St. Thomas's hospital, the celebrated author of a work on *Animal Heat* (vide page 81), is a new accession of force. Having a pulmonary complaint, he placed himself under the care of Dr. THORNTON, and declared to him, that the *hydro-carbonic air*, which he inhaled diluted with atmospheric, produced a *soothing tranquillity*, such as opium is known sometimes to produce, and he is certain, that the *correction* of the offensiveness of his expectoration is wholly to be attributed to this *new remedy*. Vide the Letters from Dr. THORNTON to Dr. BEDDOES, in his Appendix to *Considerations on the Use of Medicinal Airs*. Second edition.

\* *Inflammable air*.

ance on his master. In two consumptive patients, I am able to induce sleep *almost at pleasure* by the HYDRO-CARBONIC AIR \*. In a great majority of such cases, it is well known that the nights are exceedingly disturbed in spite of *opium* freely administered. The soporific virtue of HYDRO-CARBONATE seems however, from the experience I have had, by no means confined to consumption.

The analogy which obtains between *sleep* and the state of *torpor*, is so striking, and at the same time so applicable to the present subject, that it seems to deserve more attention than has yet been bestowed upon it.

The class of *dormant animals*, says the celebrated natural historian, M. de BUFFON, are not, as vulgarly imagined, in a state of absolute *sleep*, for the respiration is scarce perceptible, and the blood is cold, or scarcely exceeds the temperature of the outward air. There is little reason then to wonder why these animals, so inferior comparatively to others in point of heat, should become torpid, as soon as their own small portion of internal heat ceases to be assisted by the external warmth of the air: a circumstance which naturally happens when

\* A mixture of *fixed* and *inflammable* airs.

the thermometer is not more than 10 or 11 degrees above congelation. The same extends to all torpid animals during the winter. Alike are its effects on the dormouse, the hedge-hog, and the bat. Of this class the *marmot* is the most remarkable, which delights in the regions of ice and snow, and is never found but on the highest mountains: it, nevertheless, of all others is the most liable to be rendered torpid by cold.

This animal, though extremely active in summer, lays up no provision for the winter, because such a precaution would be useless\* during its dormant state. But when he perceives the first approaches of the season, in which his vital motions are to continue in a great measure suspended, HE CLOSES UP THE APERTURES OF HIS SUBTERRANEAN DWELLING WITH SUCH SOLIDITY, THAT IT IS MORE EASY TO OPEN THE EARTH ANY WHERE ELSE, THAN WHERE HE HAS CLOSED IT. When their retreat is discovered, they are found, each *rolled into a ball*, and apparently lifeless. In this state, they may be dragged roughly along the ground, or even killed, without testifying any sense of pain.

\* The *bees*, which were transported to BARBADOES, and other western islands, ceased to lay up honey *after* the first year, and are become very troublesome; but those in JAMAICA continue to make honey, as the cold north winds, or rainy seasons of that island, confine them at home for several weeks together.—Dr. DARWIN.



By a *mild and gradual heat alone*, are they to be recovered from this torpor, and if brought suddenly before a *fire*, they *perish*. A few degrees above the tenth or eleventh degree are sufficient to re-animate them; and if they are kept in a *warm* place during the winter, they do not become torpid, but continue as lively as at any other time. If the marmot remains longer torpid than the dormouse, it is probably because the weather of the climate is longer cold.

It is curious, adds M. de BUFFON, to observe this animal, when he is prematurely forced to pass from the torpid to an active state. He first yawns, fetches a deep sigh, and utters broken inarticulate sounds like a drunken man. His limbs become less rigid, he stretches out his legs, fetches another still deeper sigh, opens his eyes, and at length recovers: Such are the uneasy sensations he visibly undergoes, from a sudden and forced re-animation; which is probably performed in a more gentle and imperceptible way by the vernal warmth, when left in his cell.—*But what is singular*, HE NEVER BECOMES TORPID, THOUGH EXPOSED TO A DEGREE OF COLD EQUAL TO THAT OF FREEZING, PROVIDED HE IS KEPT IN THE *open air* INSTEAD OF A CLOSE PLACE.

From

From the circumstance of these animals excluding all communication with the external atmosphere, may not the *stagnant air* of the cell, contaminated by their respiration, and saturated with *carbonic gas*, add considerably to the *sedative effects* of *cold* in bringing on *torpor* \* ?

---

It is curious to observe how the *animal* and *vegetable tribes* mutually support each other, through their whole existence ! Vegetables, by emitting *vital air* during the day, purify the atmosphere for the use of animals ; while the *fixed air* expired by animals affords nourishment to vegetables. But at the time when this diffusive stimulus is less wanted, sleep being desirable, the vegetable race then pours forth *azotic air* †.

\* From the account of Mr. Wildman, and other people of nice observation, it appears, that during the very severe part of the winter season *bees* are *torpid*, and do not consume any of their provision. As the death of our hives of bees arise frequently from the cold not being sufficiently great to render them torpid, at which time they require the provision that has been taken from them, I directed, says Dr. DARWIN, two hives to be placed in a *confined cellar*, and observed, during all that time, they did not consume any of their stock of provision, for their weight did not decrease, as it had done when they were kept in the *open air*. Might not a direct experiment with *fastidious air* turn out, with regard to *bees*, of *twofold advantage* ?

† Vide Part I. p. 29.

With

With what ADMIRABLE OECONOMY has the SUPREME ARCHITECT then established this *reciprocal intercourse* between the *animal* and *vegetable kingdoms*! By what ELEGANT SIMPLICITY OF DESIGN are the different parts of nature thus rendered at once subservient to the mutual support of each other respectively, and to the general well-being and harmony of the whole \*!

\* FROM Dr. FOTHERGILL's Essay on *the Suspension of Vital Action*, whose able deductions, strong reasoning, and ingenious queries, we shall have frequent occasion to notice.

## SECT. XLIII.

## OF REST.

*Sleep and wakefulness* bear a great resemblance to *exertion* and *rest*; as *wakefulness* is the natural state of *action*, in which the animal machine is fatigued and wasted, and *sleep* the state of *ease*, in which it is refreshed and repaired. Thus we may look upon the time of being *awake* and *active* as the time of wearing out the animal frame; and the time of *sleep* and *rest*, as that in which it is repaired and recruited; for, in action, the *irritable principle* is continually taken from the muscular fibres, which cannot otherwise be replaced than by *rest*.

1. *Of Voluntary Action.*

Not only the *will*, by which the electric fluid is sent into the muscles, but the *muscles* themselves seem, as it were, to get fatigued by exertion, and require a certain time to recruit their powers: for in every contraction of a fibre, there is an expenditure of the *irritable principle*; and where the exertion of the voluntary powers

has been for some time increased, and the muscles or organs of motion have in consequence acted with greater energy, their propensity to activity is proportionally lessened; which can be ascribed to nothing else but the *exhaustion* or *diminution* of the IRRITABLE PRINCIPLE. Indeed every one must have experienced the refreshment arising from *repose*, and it is an established fact, that for a horse to perform a long journey, he should be previously kept at rest for several days in the stable.

Upon waking after profound sleep we stretch our limbs, which arises from the *accumulation* of the *irritable principle* in the fibres. From the same cause, when the muscles of our face have been long in a state of inaction, we yawn: and children and young animals, who have abundant irritability, are impatient of confinement, and seem never easy but in a change of position.

## 2. Of Involuntary Action.

After animal fibres have for some time been exerted into contraction, a *relaxation* succeeds, even though the exciting cause continues to act. In respect to the *irritative motions* this is exemplified in the peristaltic contractions of the bowels, and the beatings of the heart; which

which cease and are renewed alternately, though the stimulus of the aliment and blood continue to be uniformly applied: in *sensitive motions*, as in fits of the stone and gravel, and in parturition, though the stimulus is perpetual. In our *muscular exertions* it is experienced, as no one can hang long by the hands, however vehemently he wills so to do; and the changes of our attitude evinces the necessity of relaxation to those muscles which have been long in action \*.

The application of a stimulus, whether that stimulus be material or mental, excites the correspondent irritable and sentient principles into action, and this causes the contraction of the fibre and the sensation of the nerve. On the contraction of the fibre a part of the *irritable principle* † becomes expended, and the fibre, as was said before, ceases to contract, though the stimulus

\* Vide page 459.

† The two principles, viz. the *irritable* and *sentient principles*, are here mentioned as distinct. Dr. DARWIN confounds them under one and the same title, and calls them by the very expressive term, **SENSORIAL POWER**. Whether this be the *irritable principle* itself (whatever this principle may be), or *oxygen*, or *electricity*, upon which its powers depend, the reasoning is equally true: for as a philosopher (Dr. FOTHERGILL.) well expresses it,

CAUSA LATET—VIS EST NOTISSIMA.

*The cause may lie concealed; but its power is most evident.*



continues to be applied ; till in a certain time the fibre, having received a supply of the *irritable principle*, is ready to contract upon the application of a stimulus. If the stimulus on the contrary be withdrawn, the same quantity of *irritable principle* soon becomes resident in the fibre as before its contraction ; as appears from the readiness for action of the large locomotive muscles of the body in a short time after common exertion, and in those muscular fibres which are subject to constant stimulus, as the arteries, glands, and capillary vessels ; and on this account those muscular fibres become afterwards excitable into their *natural actions* by a much weaker stimulus ; or into *unnatural violence* of action by their *accustomed stimulus*, as is seen in the hot fits of intermittent fevers, which are in consequence of the previous cold ones. Thus as the minute vessels of the skin are constantly stimulated by the fluid matter of heat ; if the quantity of this stimulus of heat be a while diminished, as in covering the hands with snow, the vessels cease to act, as appears from the paleness of the skin ; if this cold application of snow be continued but a short time, the *irritable principle*, which had habitually been supplied to the fibres, becomes now *accumulated* in them,

them, owing to the want of its being expended by their accustomed contractions ; and thence a less stimulus of heat will now excite them into violent contractions. Thus on a frosty day with a bleak wind, the face of a person exposed to the wind is at first pale and shrunk ; but on turning the face from the wind, it becomes soon of a glow, with warmth and flushing. The glow of the skin in emerging from the bath is owing to the same cause ; for by lessening the quantity of heat for a minute or two by going into the cold bath, a great *accumulation* of the *irritable principle* is necessarily produced. On emerging from the bath the irritable fibre is therefore thrown into greater exertion by the stimulus of the common degree of the warmth of the atmosphere, and a great increase of *animal heat* ensues\*.

This experiment of cold bathing presents us with a simple FEVER-FIT ; for the pulse is weak, small, and quick, during the cold immersion ; and becomes strong, full, and quick, during the subsequent glow of heat ; till at length all these unnatural exertions spontaneously subside with the increased irritability that pro-

\* This has been more fully explained when on the subject on the manner of *catching cold*, page 432.

duced them; just as the eye, on coming from darkness into day-light, in a little time ceases to be dazzled and pained, and gradually recovers its natural and sufficient supply of the *irritable principle*.

We will consider the symptoms in consequence of the *quiescence* which begins the fits of fever.—From the *quiescence* of the intestinal canal a loss of appetite and flatulencies proceed. From the partial *quiescence* of the glandular viscera a swelling and tension, not unfrequently about the præcordia, becomes sensible to the touch; which is occasioned by the delay of the fluids from the defect of venous or lymphatic absorption. The pain of the forehead, and of the limbs, and of the small of the back, arises from the *quiescence* of the membranous fascia, or muscles of those parts, in the same manner as the skin becomes painful when the vessels, of which it is composed, become *quiescent* from cold. The trembling is in consequence of the pain of coldness; the yawning, shuddering, and rigors, are exertions for the removal of pain and accumulated irritability. Sickness and vomiting is a frequent symptom in the beginning of fever-fits, for the muscular fibres of the stomach share the general torpor; its motion becomes first lessen-

ed, and then retrograde \*. The small pulse, which is slow at the commencement, and which is frequently trembling and intermittent, is owing to the *quiescence* of the heart and arterial system, and to the resistance opposed to the circulating fluid from the inactivity of all the glands and capillaries. The great weakness and inability to voluntary motions, with the insensibility of the extremities, are owing to the *general quiescence* of the whole moving system. If all these symptoms are further increased, the *quiescence* of all the muscles, including the heart and arteries, becomes complete, and death ensues. This is, most probably, the case of those who are starved to death with cold, and of those who are said to die in Holland from long skating on their frozen canals.

This *accumulation*, therefore, of the *irritable principle*, if it happens to the vessels of the skin from want of heat, occasions the pain of cold; and if to the arterial system,

\* Such is the construction of animal bodies, that all their parts, when subjected to less stimuli than nature designed, perform their natural functions badly. Thus, with respect to the stomach, uneasiness is first produced, then sickness, and at length efforts to vomit. In hysteria, and other complaints, this inclination may be removed by opium or wine; but here perhaps the defect is not so much in the nature of the stimuli in contact with the fibre, as to the *temporary deficiency* of the IRRITABLE PRINCIPLE, or, as was formerly said, of *VIS VITÆ* (*owers of life*).

from

from the want of its adapted stimuli, many disagreeable sensations are occasioned, such as are experienced in the cold fits of intermittent fevers, and are as various as there are glands or membranes in the system, and are generally termed universal uneasiness.—But as soon as this *general quiescence* of the system ceases ; from the *accumulation* of *sensorial power*, which is the natural consequence of *previous quiescence*, the HOT-FIT commences. The heart is now roused to inordinate action, the skin becomes red, and the body is suffused with heat. Every gland, as its powers of action are increased by the *accumulation* of the *irritable principle* during its late quiescence, is now stimulated into stronger action than is natural, and hence a superabundance of all the secretions is produced. The urine during the *cold fit* is in small quantity and pale, both from a deficiency of the secretion, and a deficiency of the absorption. During the *hot fit* it is in its usual quantity, but very high coloured and turbid, because a greater quantity had been secreted by the increased action of the kidneys, and also a greater quantity of its more aqueous parts had been absorbed from it in the bladder by the increased action of the absorbents. This violent exertion not only diminishes  
the

the *accumulated irritability* in the system, but at the same time induces, first, pleasure, and soon after pain; which, whether it be succeeded by inflammation of the brain, lungs, or pleura, or not, becomes an additional stimulus; and acting along with the former ones, produces still greater exertions, until this storm of nature sinks into a silent calm, or, to use another metaphor, leaves the patient below par. Now, when the *irritable principle* is thus *exhausted* by *useless exertions* (for here this accommodating temper of nature is an evil \*, if such an expression may be used), the different organs of the body become as it were torpid, and a *second fit* of *quiescence* succeeds that of *abundant activity* †. During this second fit of quiescence the *irritable principle* becomes again *accumulated*, and another fit of exertion follows in train. These vicissitudes of exertion and inertia

\* See a vindication of the wisdom and goodness of GOD in the *establishment* of GENERAL LAWS, Section the last.

† Sometimes, however, the fibre seems as it were overpowered by its state of *quiescence*, and the IRRITABLE PRINCIPLE does not again *accumulate* in the fibre, as was explained when relating the effects of the cold bath, page 417, and as will be fully explained when we come to treat of HYDROTHORAX (water in the chest), succeeding to *inflammation of the lungs*, ANASARCA (general dropsy), from the *abuse of spirituous liquors*, and TYPHUS (putrid fever) commencing with *synocha* (violent inflammatory fever).

constitute



constitute the paroxysms of remittent fevers, or intermittent ones, when there is an interval of nearly the natural action of the arteries between the exacerbations, and it will be shewn in Part IV.\* that upon this principle chiefly the cure of such fevers depends.

\* Vide the Sections on FEVERS.

SECT.

## SECT. XLIV.

## OF HUNGER.

THERE are *three classes* of readers.

1. The *first class* are those who wish to find in a work the union of the *agreeable* with the *useful*. For this class of readers the present work is attempted to be formed.

2. The *second class* are those who seek only for what is *profitable*. This class may select from the table of contents such information *only* as they wish.

3. The *third and more numerous class* of readers are those who devour in a few hours a whole work, and digest no part of it; who read merely for the sake of saying they are not *ignorant* of the contents of any popular work. This class of readers will find their account answered by reading the abridged view of this book in the table of contents, which, to tell the truth, was not designed for them, but to refresh the memory of the first class of readers.

As the narrative of the voyage of Captain BLIGH to the south seas, for the purpose of conveying the BREAD-

TREE to the *West Indies*, and his *sufferings* and *preservation*, are very interesting, and appertain to the subject of this section, it is presumed, that a detail of them will not be found unacceptable to that class of readers for whom this work is compiled. They are therefore recorded at greater length than the two latter classes will approve of; but to these *our apology* is presented in our analytical table of contents.

#### CAPTAIN BLIGH'S NARRATIVE.

THE king having been graciously pleased to comply with a request from the merchants and planters interested in his Majesty's *West-India* possessions, that the BREAD-FRUIT TREE \* might be introduced into those

\* In the *Society Islands* the BREAD-FRUIT grows on a tree that is the size of a middling oak; its leaves are frequently about a foot and a half long, of an oblong shape, deeply sinuated like those of the fig tree, which they resemble in colour, and in the exuding of a white milky juice upon being broken. *The fruit is about the size and shape of a child's head.* The eatable part lies between the skin and the core; it is as *white as snow*, and somewhat of the consistence of new bread. It serves as the principal food to the inhabitants of these islands, to procure which costs them nothing but the labour of climbing the tree. This tree, however, does not shoot up spontaneously; but if a man plants ten in his life-time, which he may do in about an hour, he will as completely fulfil his duty to his own and future generations, as the native of our less temperate climate can do by ploughing in the cold winter, and

those islands, a vessel, proper for the undertaking, was bought, and taken into dock at *Deptford*, to be provided with the necessary fixtures and preparations for executing the object of the voyage. These were completed according to a plan made by Sir JOSEPH BANKS, which, in the event, proved the most advantageous that could have been adopted for the intended purpose.

The ship was named *Bounty*. Lieutenant WILLIAM BLIGH was appointed to command her. The great cabin was appropriated for the preservation of the plants. It had two large sky-lights, and on each side three skuttles for air, and was fitted with a false floor cut full of holes to contain the garden-pots, in which the plants were to be brought home. The deck was covered with lead, and at the foremost corners of the cabin were fixed pipes to carry off the water that drained from the plants, into tubs placed below to save it for future use.

The ship was flored and victualled for eighteen months. In addition to the customary allowance of provisions, it was supplied with four krout, portable soup, essence of malt, and a proportion of barley and

and reaping in the summer's heat, as often as these seasons return: even if, after he has procured bread for his present household, he should convert a surplus into money, and lay it up for his children. From Captain Cook's *Voyage*, Vol. II.

wheat. The captain was likewise furnished with a quantity of iron-work and trinkets, to serve in his intercourse with the natives in the *South Seas*.

The *object* of all the former voyages to the *South Seas*, undertaken by the command of his present majesty, has been the advancement of science and the increase of knowledge. This voyage may be reckoned the first, the intention of which has been to derive *benefit* from those distant discoveries.

<p>To Lieut. WILLIAM BLIGH, commanding his Majesty's armed vessel the BOUNTY, at Spithead,</p>	<p>By the Commissioners for executing the office of Lord High Admiral of GREAT BRITAIN and IRELAND, &amp;c.</p>
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WHEREAS the king, upon a representation from the merchants and planters interested in his majesty's WEST INDIA possessions, that the introduction of the *bread-fruit tree* into the islands of those seas, to constitute an article of food, would be of very essential benefit to the inhabitants, hath, in order to promote the interests of so respectable a body of his subjects (especially in an instance which promises general advantage) thought fit that mea-  
sures

fures should be taken for the procuring some of those  
 trees, and conveying them to the said WEST INDIA  
 islands: and whereas the vessel under your command  
 hath, in consequence thereof, been stored and victualled  
 for that service, and fitted with proper conveniences and  
 necessaries for the preservation of as many of the said  
 trees as, from her size, can be taken on board her; and  
 you have been directed to receive on board her the two  
 gardeners named in the margin, who, from their know- David Nelson  
 ledge of trees and plants, have been hired for the pur- and  
 pose of selecting such as shall appear to be of a proper Wm. Brown.  
 species and size:

You are, therefore, in pursuance of his majesty's  
 pleasure, signified to us by Lord SYDNEY, one of his  
 principal secretaries of state, hereby required and directed  
 to put to sea in the vessel you command, the first favour-  
 able opportunity of wind and weather, and proceed with  
 her, as expeditiously as possible, round *Cape Horn*, to  
 the SOCIETY ISLANDS, situate in the *southern*  
*ocean*, in the latitude of about  $18^{\circ}$  south, and longitude  
 of about  $210^{\circ}$  east from Greenwich, where, according  
 to the accounts given by the late Captain Cook, and  
 persons who accompanied him during his voyages, the  
*bread-*



*bread-fruit tree* is to be found in the most luxuriant state.

Having arrived at the above-mentioned islands, and taken on board as many trees and plants as may be thought necessary (the better to enable you to do which, you have already been furnished with such articles of merchandize and trinkets as it is supposed will be wanted to satisfy the natives) you are to proceed from thence through *Endeavour Streights* (which separate NEW HOLLAND from NEW GUINEA) to *Prince's Island*, in the *Streights of Sunda*, or, if it should happen to be more convenient, to pass on the eastern side of *Java* to some port on the north side of that island, where any *bread-fruit trees* which may have been injured, or have died, may be replaced by *Mangosteens*, *Duriens*, *Jacks*, *Nancas*, *Lansas*, and other fine fruit trees of that quarter, as well as the *Rice Plant* which grows upon dry land; all of which species (or such of them as shall be judged most eligible) you are to purchase on the best terms you can from the inhabitants of that island, with the ducats with which you have also been furnished for that purpose; taking care, however, if the rice plants above mentioned cannot be procured at *Java*, to  
touch

touch at *Prince's Island* for them, where they are regularly cultivated.

From *Prince's Island*, or the Island of *Java*, you are to proceed round the Cape of *Good Hope* to the WEST INDIES (calling on your way thither at any places which may be thought necessary) and deposit one half of such of the above-mentioned trees and plants as may be then alive at his majesty's botanical garden at *St. Vincent*, for the benefit of the Windward Islands, and then go on to *Jamaica*: and, having delivered the remainder to Mr. EAST, or such person or persons as may be authorized by the governor and council of that island to receive them, refreshed your people, and received on board such provisions and stores as may be necessary for the voyage, make the best of your way back to England; repairing to *Spithead*, and sending to our secretary an account of your arrival and proceedings.

And whereas you will receive herewith a copy of the instructions which have been given to the above-mentioned gardeners for their guidance, as well in procuring the said trees and plants, and the management of them after they shall be put on board, as for bringing to England a small sample of each species, and such others as may be prepared by the superintendant of the botanical

garden at *St. Vincent's*, and by the said Mr. EAST, or others, for his majesty's garden at Kew ; you are hereby required and directed to afford, and to give directions to your officers and company to afford, the said gardeners every possible aid and assistance, not only in the collecting of the said trees and plants at the places before mentioned, but for their preservation during their conveyance to the places of their destination.

Given under our hands the 20th November, 1787.

HOWE,

C. BRETT,

R. HOPKINS,

J. LEVESON GOWER.

By command of their Lordships,

P. STEPHENS.

After a voyage of ten months the ship *Bounty* arrived safe at OTAHEITE. As they drew nigh, a great number of canoes came off to them. Their first inquiry was, whether they were friends, and whether they came from *Britain*. They were no sooner satisfied in this, than they crowded on board in vast numbers, notwithstanding the endeavours which were made to prevent it ;  
and

and in less than ten minutes, the deck was so full that the captain could scarce find his own people.

The next morning I went on shore, says Captain BLIGH, with the chief POENO, accompanied by a multitude of the natives. He conducted me to the place where we had fixed our tents in 1777, and desired that I would appropriate the spot to the same use. We then went across the beach, and through a walk delightfully shaded with *bread-fruit trees*, to his house. Here we found two women at work staining a piece of cloth red. These were his wife and her sister. They desired me to sit down on a mat, which was spread for the purpose, and with great kindness offered me refreshments. I received the congratulations of several strangers, who came up to us and behaved with great decorum and attention. The people, however, thronged about the house in such numbers that I was much incommoded by the heat, which being observed, they respectfully drew back. They made many enquiries after Sir JOSEPH BANKS, and many of their former friends. They said a ship had been there, from which they had learnt that Captain COOK was dead, but the circumstances of his death they did not appear to be acquainted with. The captain they called TONAH. I understood likewise from them that

Licut. WATTS was in the ship; who, having been here in the *Resolution* with Captain Cook, was well known to them. In turn I very eagerly enquired after my friend OMAI; and it was a sensible mortification and disappointment to me to hear that not only OMAI, but both the New Zealand boys who had been left with him, were dead. Every one agreed in their information that they died a natural death. I next enquired about the cattle that had been left here by Captain Cook, but the accounts I received were very unfavourable, and so various, that for the present I shall forbear speaking of them. I had, however, the satisfaction to find that the island had received some benefit from our former visit. Two *shaddocks* were brought to me, a fruit which they had not till we introduced it. And among other things were *capficoms*, *pumkins*, and two young *goats*.

This forenoon, a man came on board with Captain Cook's picture, which had been drawn by Mr. WEBBER, in 1777, and left with OTOO. It was brought to me, says Captain BLIGH, to be repaired. The frame was broken, but the picture no way damaged, except a little in the back ground. They called it TOOTE (which has always been their manner of pronouncing Captain Cook's

Cook's name). They said TOOTE had desired OTOO, whenever any English ship came, to shew the picture, and it would be acknowledged a token of friendship.

The next morning early, I received a message from OTOO, to inform me of his arrival from the back of the island, and requesting I would send a boat for him, which I immediately did, with an officer to conduct him on board. He came with numerous attendants, and expressed much satisfaction at our meeting. After introducing his wife to me, we *rubbed our noses together*, which is the customary manner of saluting.

I was surpris'd to find, that, instead of OTOO, the name by which he formerly went, he was now called TINAH. The name of TINAH's wife was IDEAH: with her was a woman, dressed with a large quantity of cloth, in the form of a hoop, which was taken off and presented to me, with a large hog, and some bread-fruit. I then took my visitors into the cabin, and after a short time produced my presents in return.

The present I made to TINAH (by which name I shall hereafter call him) consisted of hatchets, small adzes, files, gimblets, saws, looking-glasses, red feathers, and two shirts. To IDEAH I gave ear-rings, necklaces,



and beads; but she expressed her desire for the utensils of iron.

Much conversation took place among them on the value of the different articles, and they appeared extremely satisfied; so that they determined to spend the day with me.

In the evening TINAH desired me to fire some of the great guns: this I readily complied with, and, as the shot fell into the sea at a great distance, all the natives expressed their approbation by loud shouts and acclamations.

I had a large company at dinner; for, besides TINAH and his wife, there was OTOW, the father of TINAH, OREPYAH, and WHYDOAH, two of his brothers, PAENO, and several other chiefs.

TINAH is a very large man, much above the common stature, being not less than six feet four inches in height, and proportionably stout: his age about thirty-five.

His wife (IDEAH) I judged to be about twenty-four years of age: she is likewise much above the common size of the women of *Otaheite*, and has a very animated and intelligent countenance.

WHYDOAH, the younger brother of TINAH, was highly

highly spoken of as being a great warrior, and had also the reputable character of being the greatest drunkard in the country; and indeed, to judge from the withered appearance of his skin, he must have used the *ava* to excess.

TINAH was fed by one of his attendants, who sat by him only for that purpose, this being a particular custom among some of the superior chiefs; and I must do him the justice to say, he excelled in this as his brother did in drinking, as he kept his attendant in constant employment: there was indeed little reason to complain of want of appetite in any of the guests.

As the women are not allowed to dine in company with the men, IDEAH dined with some of her companions, about an hour afterwards, in private, except that her husband TINAH favoured them with his company, and seemed to have entirely forgotten that he had already dined.

TINAH continued with me the whole afternoon, in the course of which he eat (having requested it) *four times* of pork, *besides* his dinner.

In the morning I returned TINAH's visit. I made him understand, that my visit was designed as a particular compliment to him, and gave him a second pre-

sent, equal to the first, which he received with great pleasure ; and to the people of consequence, that were about him, I also presented some article or other. There were a great number of children ; and, as I took notice of the little ones that were in arms and gave them beads, both small and great, but with much drollery and good humour, endeavoured to profit by the occasion. Boys, and even grown up persons, were caught up in arms and brought to me, which created much laughter ; so that in a short time I got rid of all I had brought on shore.

My next object was to go to *Opur*, to see if NELSON could be able to procure any plants there, but I gave the credit of my visit to young OTOO, the eldest son of TINAH, and who had taken his name.

I prepared a magnificent present for this youth, who was represented to me as a person of the highest rank in the island.

TINAH, understanding from my conversation that I intended visiting some of the neighbouring islands, very earnestly requested I would not think of leaving *Mata-vai*. “ Here,” said he, “ you shall be supplied plentifully with every thing you want. All here are your friends, and friends of King GEORGE : if you go to  
“ the

“the other islands, you will have every thing stolen from you.” I replied, that, on account of their good will, and from a desire to serve him and his country, King GEORGE had sent out those valuable presents to him; and will not you, TINAH, send something to King George in return? “Yes,” he said, “I will send him any thing I have;” and then began to enumerate the different articles in his power, among which he mentioned the BREAD-FRUIT. This was the exact point to which I wished to bring the conversation; for I had given directions to every one on board not to make known to the islanders the purpose of our coming, lest it might enhance the value of the *bread-fruit* plants, or occasion other difficulties; and, seizing an opportunity which had every appearance of being undesigned and accidental, I told him the *bread-fruit trees* were what I was sure King GEORGE would like; upon which he promised me a great many should be put on board, and seemed much delighted to find it so easily in his power to send any thing that would be well received by King GEORGE.

The next day I sent Mr. CHRISTIAN with a party to erect our tent, and soon after followed him myself. With the consent of TINAH, MOANNAH, and POENO,  
I fixed

I fixed a boundary, within which the natives were not to enter without leave, and the chiefs cautioned them against it. The principal use of the tents on shore was for a lodgment for the plants; which, instead of appearing to receive as a favour, I brought the chiefs to believe I was doing them a great honour in carrying these plants as a present from them to the EAREE RABIE NO BRITANNEE. The party at the tent consisted of nine persons, including NELSON and his assistant.

TINAH dined with me on board, and was to-day my only visitor: nevertheless, the ceremony of being fed he so scrupulously observed, that, even after all the attendants were sent away, and we were left by ourselves, I was obliged to feed him myself.

I had frequently large companies to dine with me. Some of my constant visitors had observed that we always drank the king's health, as soon as the cloth was removed; but they were by this time so fond of wine, that they would frequently remind me of the health in the middle of dinner, by calling out King GEORGE EAREE NO BRITANNEE; and would banter me if the glass was not filled to the brim. Nothing could exceed the mirth and jollity of these people when they met on board.

MONDAY,

MONDAY, JANUARY 5, 1789. At the relief of the watch, four o'clock in the morning, the small cutter was missing. I was immediately informed of it, and mustered the ship's company; when it appeared that three men were absent, Charles CHURCHILL, the ship's corporal; and two of the seamen, William MUSPRAT, and John MILLWARD. They had taken with them eight stand of arms and ammunition; but what their plan was, or which way they had gone, no one on board seemed to have the least knowledge. I went on shore to the chiefs, and soon received information that the boat was at *Matavai*; and that the deserters had departed in a sailing canoe for the island TETHUROA.

On this intelligence I sent the master to *Matavai* to search for the small cutter, and one of the chiefs went with him; but before they had got half way, they met the cutter with five of the natives, who were bringing her back to the ship. This service, rendered me by the people of *Matavai*, pleased me much, and I rewarded the men accordingly.

I told TINAH and other chiefs, that I expected they would get the deserters brought back; for that I was determined not to leave *Otaheite* without them. They assured me, that they would do every thing in their



power to have them taken; and it was agreed that OREPYAH and MOANNAH should depart the next morning for *Tethuroa* to seize them.

THURSDAY, JANUARY 22, 1789. This afternoon I received a message from TEPPAHOO, to inform me that our deserters had roamed about, but were now at *Jettaba*. I ordered the cutter to be got ready, and a little before sun-set left the ship, taking ADIDE with me. When we arrived at TEPPAHOO's house, we were very kindly received by him and his wife. The deserters, he informed me, were in a house close to us, and I imagined there would not be much difficulty in securing them with the assistance of the natives. They had heard of my arrival; and when I was near the house, they came out, without their arms, and delivered themselves up.

I learnt from the deserters, that at *Tethuroa* they had seen OREPYAH and MOANNAH, who had made an attempt to secure them. They said it was their intention to have returned to the ship; and it is probable that they were so much harassed by the natives watching for an opportunity to surprise them, that they might wish to have the merit of returning of their own accord, to avoid the disgrace of being seized and brought back.

FRIDAY

FRIDAY, FEBRUARY 6. An occurrence happened to-day that gave me great concern, not only on account of the danger with which the ship had been threatened, but as it tended to diminish the confidence and good understanding which had hitherto been constantly preserved between us and the natives. The wind had blown fresh in the night, and at day-light we discovered that the cable, by which the ship rode, had been cut near the water's edge, in such a manner, that only one strand remained whole.

While we were securing the ship, TINAH came on board. I could not but believe he was perfectly innocent of the transaction; nevertheless, I spoke to him in a very peremptory manner, and insisted upon his discovering and bringing to me the offender.

My suspicions fell chiefly, I may say wholly, on the strangers that came to us from other parts of the island; for we had on every occasion received such unreserved and unaffected marks of good will from the people of *Matavai* and *Opar*, that in my own mind I entirely acquitted them.

The anger which I expressed, however, created so much alarm, that old OTOW and his wife (the father and mother of TINAH) immediately quitted *Opar*, and

retired to the mountains in the midst of heavy rain, as did TEPPAHOO and his family.

TINAH and IDEAH expostulated with me on the unreasonableness of my anger against them. He said, he would exert his utmost endeavours to discover the guilty, that most probably the attempt had been made by people from the other islands out of enmity to the inhabitants of *Matavai* and *Opar*, every one knowing the partiality I had for them, and that I had declared I would protect them against their enemies.

All this I believed, but I did not think proper to appear perfectly satisfied, lest TINAH, who was naturally very indolent, should not be active in his endeavours to detect the offender.

Saturday passed without my seeing any thing of TINAH the whole day. The next morning, he and IDEAH came to me, and assured me they had made the strictest enquiries concerning the injury intended us, but had not been able to discover any circumstance which could lead them to suspect who were concerned in it. This was not at all satisfactory, and I behaved to them with great coolness, at which they were much distressed; and IDEAH, at length, gave vent to her sorrow by tears. I could no longer keep up the appearance of mistrusting them ;

them; but I earnestly recommended to them, as they valued the king of England's friendship, that they would exert their utmost endeavours to find out the offenders, which they faithfully promised. Our reconciliation accordingly took place, and messengers were sent to OTOW and TEPPAHOO to invite them to return.

It has since occurred to me, that this attempt to cut the ship adrift, was most probably the act of some of our own people; whose purpose of remaining at *Otaheite* might have been effectually answered if the ship had been driven on shore. At the time, I entertained not the least thought of this kind, nor did the possibility of it enter into my ideas, having no suspicion that so general an inclination, or so strong an attachment to these islands, could prevail among my people, as to induce them to abandon every prospect of returning to their native country.

TUESDAY, MARCH 31. To day, all the plants were on board, being in 74 pots, 39 tubs, and 24 boxes. The number of *bread-fruit* plants were 1015; besides which we had collected a number of other plants. The *avce*, which is one of the finest flavoured fruits in the world. The *ayyah*, which is a fruit not so rich, but of  
a fine

a fine flavour and very refreshing. The *rattah*, not much unlike a chesnut, which grows on a large tree, in great quantities: they are singly in large pods, from one to two inches broad; and may be eaten raw, or boiled in the same manner as Windsor beans, and so dressed, are equally good. The *orai-ah*, which is a very superior kind of plantain. All these I was particularly recommended to collect by Sir JOSEPH BANKS. I had also taken on board some plants of the *ettow* and *matte*, with which the natives here make a beautiful red colour; and a root called *peeah*, of which they make an excellent pudding.

FRIDAY, APRIL 3. TINAH and his wife, with his parents, brothers, and sister, dined with me to-day, and, as I meant to sail early next morning, they all remained on board for the night. The ship was crowded the whole day with the natives, and we were loaded with cocoa-nuts, plantains, bread-fruit, hogs, and goats. In the evening there was no dancing or mirth on the beach, such as we had been accustomed to, but all was mournful silence.

All the while we remained at *Otabeite*, the picture of Captain COOK, at the desire of TINAH, was kept on

board the ship. On delivering it to him, I wrote on the back, the time of the ship's arrival and departure, with an account of the number of plants on board.

SATURDAY, APRIL 4. At day-light we unmoored. At half past six, there being no wind, we weighed, and towed the ship out of harbour. Soon after the sea breeze came, and we stood off towards the sea. At sunset we bad farewell to *Otabeite*, where for twenty-three weeks we had been treated with the utmost affection and regard, and which seemed to increase in proportion to our stay. That we were not insensible to their kindness, the events which followed more than sufficiently proves: for to the friendly and endearing behaviour of these people, may be ascribed the motives for that event which effected the ruin of an expedition that, there was every reason to hope, would have been completed in the most fortunate manner.

We stood to the northward all night, with light winds, and on the 27th of April 1789, at noon, were between the islands *Tafoa* and *Kotoo*.

Thus far the voyage had advanced in a course of uninterrupted prosperity, and had been attended with many circumstances equally pleasing and satisfactory. A very different scene was, however, soon to take place. A  
conspiracy



conspiracy was formed, which was to render all our past labour productive only of misery and distress. The means was concerted and prepared with so much secrecy and circumspection, that no one circumstance occasioned the smallest suspicion of the impending calamity.

TUESDAY, APRIL 28. Just before sun-rising, while I was yet asleep, Mr. CHRISTIAN, with the master at arms, gunner's mate, and Thomas BURKITT, seaman, came into my cabin, and seizing me, tied my hands with a cord behind my back, threatening me with instant death if I spoke or made the least noise: I, however, called as loud as I could, in hopes of assistance; but they had already secured the officers who were not of their party, by placing centinels at their doors. There were three men at my cabin door, besides the four within. CHRISTIAN had only a cutlass in his hand, the others had muskets and bayonets.

I was hauled out of bed, and forced on deck in my shirt, suffering great pain from the tightness with which they had tied my hands.

I demanded the reason of such violence, but received no other answer than abuse, for not holding my tongue.

The master, the gunner, the surgeon, Mr. ELPHINSTONE,

STONE, master's mate, and NELSON, were kept confined below ; and the fore hatchway was guarded by centinels.

The boatswain and carpenter, and also the clerk, Mr. SAMUEL, were allowed to come upon deck, where they saw me standing abaft the mizen-mast, with my hands tied behind my back, under a guard, with CHRISTIAN at their head.

The boatswain was ordered *to hoist the launch out*, with a threat, if he did not do it instantly, to take care of himself.

When the boat was out, Mr. HAYWARD and Mr. HALLET, two of the midshipmen, and Mr. SAMUEL, were ordered into it.

I demanded what their intention was in giving this order, and endeavoured to persuade the people near me not to persist in such acts of violence ; but it was to no effect : Hold your tongue, fir, or you are dead this instant, was constantly repeated to me.

I continued my endeavours to turn the tide of affairs, when CHRISTIAN changed the cutlass which he had in his hand for a bayonet that was brought to him, and, holding me with a strong gripe by the cord that tied my hands, he with many oaths threatened to kill me im-

diately, if I would not be quiet : the villains round me had their pieces cocked and bayonets fixed.

Particular people were called on to go into the boat, and were hurried over the side ; whence I concluded that with these people I was to be set adrift : I therefore made another effort to bring about a change, but with no other effect than to be threatened with having my brains blown out.

The boatswain and seamen who were to go in the boat, were allowed to collect twine, canvas, lines, fails, cordage, an eight-and-twenty gallon cask of water, and Mr. SAMUEL, foreseeing what was to happen, got an hundred and fifty pounds of bread, with a small quantity of rum and wine, also a quadrant and compass : but he was forbidden, on pain of death, to touch either map, ephemeris, book of astronomical observations, sextant, time-keeper, or any of my surveys or drawings.

The mutineers having forced those of the seamen, whom they meant to get rid of, into the boat, CHRISTIAN directed a dram to be served to each of his own crew. I then unhappily saw that nothing could be done to effect the recovery of the ship : there was no one to assist me, and every endeavour on my part was answered with threats of death.

The

The officers were next called upon deck, and forced over the side into the boat, while I was kept apart from every one, abaft the mizen-mast; CHRISTIAN, armed with a bayonet, holding me by the bandage that secured my hands.

The guard round me had their pieces cocked, but on my daring the wretches to fire, they uncocked them.

Isaac MARTIN, one of the guard over me, I saw, had an inclination to assist me, and as he fed me with shaddock (my lips being quite parched) we explained our wishes to each other by our looks; but this being observed, Martin was removed from me.

He then attempted to leave the ship, for which purpose he got into the boat; but with many threats they obliged him to return.

The armourer, Joseph COLEMAN, and two carpenters, MACINTOSH and NORMAN, were also kept contrary to their inclinations; and they begged of me, after I was astern in the boat, to remember that they declared they had no hand in the transaction. Michael BYRNE likewise wanted to leave the ship.

It is of no moment for me to recount my endeavours to bring back the offenders to a sense of their duty: all I

could do was by speaking to them ; but it was to no purpose, for I was kept securely bound, and no one, except the guard, suffered to come near me.

To Mr. SAMUEL I am indebted for securing my journals and commission, with some material ship papers.

Without these I had nothing to certify what I had done, and my honour and character might have been suspected, without my possessing a proper document to have defended them. All this he did with great resolution though strictly guarded. He attempted to save the time-keeper, and a box with my surveys, drawings, and remarks for fifteen years past, which were numerous; when he was hurried away, with, “ Damn your eyes, you are well off to get what you have.”

It appeared to me, that CHRISTIAN was some time in doubt whether he should keep the carpenter or his mates ; at length he determined on the latter, and the carpenter was ordered into the boat. He was permitted, but not without great opposition, to take his tool chest.

Much altercation took place among the mutinous crew during the whole business: some swore, “ I’ll be  
“ damned if he does not find his way home, if he gets  
“ any

“ any thing with him,” meaning me; and, when the carpenter’s chest was carrying away, “ Damn my eyes, “ he will have a vessel now.” While others laughed at the *helpless situation* of the boat, being very deep, and so little room for those who were in her. As for CHRISTIAN, he appeared like a madman.

The officers and men being in the boat, they only waited for me, of which the master at arms informed CHRISTIAN; who then said, “ Come, Captain BLIGH, “ your officers and men are now in the boat, and you “ must go with them; if you attempt to make the least “ resistance you shall instantly be put to death;” and without further ceremony, with a tribe of armed ruffians about me, I was forced over the side, where they untied my hands.

Being in the boat, we were veered astern by a rope. A few pieces of pork were thrown to us, and some clothes, also four cutlasses; and it was then that the armourer and carpenters called out to me to remember that they had no hand in the transaction.

After having undergone a great deal of ridicule, and been kept some time to make sport for these unfeeling wretches, we were at length cast adrift upon the wide ocean.

I had



I had with me in the boat the following persons :

Names.	Stations.
John FRYER, - - - - -	<i>Master.</i>
Thomas LEDWARD, - - - - -	<i>Acting Surgeon.</i>
David NELSON, - - - - -	<i>Botanist.</i>
William PECKOVER, - - - - -	<i>Gunner.</i>
William COLE, - - - - -	<i>Boatswain.</i>
William PURCELL, - - - - -	<i>Carpenter.</i>
William ELPHINSTONE, - - - - -	<i>Master's Mate.</i>
Thomas HAYWARD, - - - - -	<i>Midshipman.</i>
John HALLET, - - - - -	<i>Ditto.</i>
John NORTON, - - - - -	<i>Quarter-master.</i>
Peter LINKLETTER, - - - - -	<i>Ditto.</i>
Lawrence LEBOGUE, - - - - -	<i>Sail-maker.</i>
John SMITH, - - - - -	<i>Cook.</i>
Thomas HALL, - - - - -	<i>Ditto.</i>
George SIMPSON, - - - - -	<i>Quarter-master's Mate.</i>
Robert TINKLER, - - - - -	<i>A Boy.</i>
Robert LAMB, - - - - -	<i>Butcher.</i>
Mr. SAMUEL, - - - - -	<i>Clerk.</i>

There

There remained on board the *Bounty*,

Fletcher CHRISTIAN, - - - - - *Master's Mate.*

CHRISTIAN, the head of the mutineers, is of a respectable family in the north of England. This was the third voyage he had made with me; and, as I found it necessary to keep my ship's company at three watches, I had given him an order, the night previous to the mutiny, to take charge of the third, his abilities being thoroughly equal to the task.

Peter HAYWOOD, - - - - - *Midshipman.*

HAYWOOD is also of a respectable family in the north of England, and a young man of abilities, as well as CHRISTIAN. These two had been objects of my particular regard and attention, and I had taken great pains to instruct them, having entertained hopes, that, as professional men, they would have become a credit to themselves and their country.

Edward YOUNG, - - - - - *Midshipman.*

YOUNG was well recommended, and had the look of an able stout seaman: he, however, fell short of what his appearance promised.

Edward STEWART, - - - - - *Midshipman.*

STEWART was a young man of creditable parents in the *Orkneys*; at which place, on the return of the *Resolution* from the *SOUTH SEAS* in 1780, we received so many civilities, that, on that account only, I should gladly have taken him with me: but, independent of this recommendation, he was a seaman, and had always borne a good character.

Charles CHURCHILL, - - - - - *Master at Arms.*

John MILLS, - - - - - *Gunner's Mate.*

James MORRISON, - - - - - *Ditto.*

Thomas BURKITT, - - - - - *Boatswain's Mate.*

Matthew QUINTAL, - - - - - *Able Seaman.*

John

Names.	Station.
John SUMNER, - - - - -	<i>Able Seaman.</i>
John MILLWARD, - - - - -	<i>Ditto.</i>
William MACKOY, - - - - -	<i>Ditto.</i>
Henry HILLBRANT, - - - - -	<i>Ditto.</i>
Michael BYRNE, - - - - -	<i>Ditto.</i>
William MUSPRAT, - - - - -	<i>Ditto.</i>
Alexander SMITH, - - - - -	<i>Ditto.</i>
John WILLIAMS, - - - - -	<i>Ditto.</i>
Thomas ELLISON, - - - - -	<i>Ditto.</i>
Isaac MARTIN, - - - - -	<i>Ditto.</i>
Richard SKINNER, - - - - -	<i>Ditto.</i>
Matthew THOMPSON, - - - - -	<i>Ditto.</i>
William BROWN, - - - - -	<i>Gardener.</i>
Joseph COLEMAN, - - - - -	<i>Armourer.</i>
Charles NORMAN, - - - - -	<i>Carpenter's Mate.</i>
Thomas MACINTOSH, - - - - -	<i>Carpenter's Crew.</i>

In all 25 hands, and the most able men of the ship's company.

Notwithstanding the roughness with which I was treated, the remembrance of past kindnesses produced some signs of remorse in CHRISTIAN. When they were forcing me out of the ship, I asked him, "if this treatment was a proper return for the many instances he had received of my friendship?" He appeared disturb-

ed at my question, and said, with much emotion, “ It is that, Captain BLIGH, which affects me, and makes me in hell.”

Having little or no wind, we rowed pretty fast toward *Tofoa*, which bore NE about 10 leagues from us.

While the ship was in sight she steered NNW, but I considered this only as a feint; for when we were at a distance, “ *Huzza for Otabeite*,” was frequently heard among the mutineers.

As soon as I had time to reflect, I felt an inward satisfaction, which prevented any very great depression of spirits: conscious of my integrity, and anxious solicitude for the good of the service in which I had been engaged, I found my mind very much supported, and began to conceive hopes, notwithstanding so heavy a calamity, that I should one day be able to account to my king and country for the misfortune.

A few hours before, my situation had been peculiarly flattering. I had a ship in the most perfect order, and well stored with every necessary both for service and health: by early attention to those particulars, I had, as much as lay in my power, provided against any accident, in case I could not get through *Endeavour Straits*, as well as against what might befall me in them; added to

this, the plants had been successfully preserved in the most flourishing state: so that, upon the whole, the voyage was two thirds completed, and the remaining part, to all appearance, in a very promising way; every person on board being in perfect health, to establish which was ever amongst the principal objects of my attention.

It may be very naturally asked, what could be the reason for such a revolt? In answer to which I can only conjecture, that the mutineers had flattered themselves with the hopes of a more happy life among the *Otaheiteans*, than they could possibly enjoy in England; and this, joined to some female connections, most probably occasioned the whole transaction.

The women of *Otaheite* are handsome, mild, and cheerful in their manners and conversation, possessed of great *sensibility*, and have sufficient *delicacy*\* to make them

\* *Modesty* is one of the most distinguishing and *attractive* characteristics of the female sex. *Modesty* has a double effect: it heightens the desire of the male, and deters him from rudeness, or improper behaviour. It both *attracts* and *repels*. There is no part of the female character which men revere so much as *modesty*. It is the brightest and most valuable jewel with which a woman can be adorned. A fine woman without *modesty*, instead of gaining the affections of men, becomes an object of contempt. It is, therefore, not only the interest of females to cultivate *modesty*, but to guard, with the most anxious

them admired and beloved. The chiefs were so much attached to our people, that they rather encouraged their stay among them than otherwise.

Under these, and many other attendant circumstances equally desirable, it is now perhaps not so much to be wondered at, though scarcely possible to have been foreseen, that a set of sailors, most of them void of connection, should be led away; especially when, in addition to such powerful inducements, they imagined it in their power to fix themselves in the midst of plenty, on one of the finest islands in the world, where they need not

anxious attention, against the smallest encroachments. Every attack, however apparently insignificant, should be repelled with spirit and intrepidity. To men of sensibility a single glance of the eye will tell them that their conduct is improper, and make them not only instantly desist, but prevent any future attempt. It is equally the interest of men to cherish, and not to injure by indelicacy, a quality from which they derive so much pleasure and advantage.

Hail, MODESTY! fair female honour, hail!

Beauty's *chief ornament*, without whose charms beauty disgusts; or gives but vulgar joys.

CHEAPNESS offends; hence on the *harlot's* lip no rapture hangs, however fair she seem,  
however form'd for love and amorous play.

THOU giv'st the *smile its grace*; the *heighten'd kiss its balmy essence sweet*! &c.

ARMSTRONG.

It is curious to observe the power of this quality in the present instance over *rude minds*.

3 T 2

labour,



labour, and where the allurements of dissipation are beyond any thing that can be conceived.

The utmost, however, that any commander could have supposed to have happened is; that some of the people would have been tempted to desert. But if it should be asserted, that a commander is to guard against an act of mutiny and piracy in his own ship, more than by the common rules of service; it is as much as to say that he must sleep locked up, and when awake be girded with pistols, and walk among his men as amidst a gang of robbers.

Desertions have happened, more or less, from most of the ships that have been at the *Society Islands*; but it has always been in the commander's power to make the chiefs return their people: the knowledge, therefore, that it was *unsafe* to desert, perhaps, first led mine to consider with what ease so small a ship might be surprised, and that so favourable an opportunity would never offer to them again.

The *secrecy* of this mutiny is beyond all conception. Thirteen of the party, who were with me, had always lived forward among the seamen; yet neither they nor the messmates of CHRISTIAN, Stewart, Haywood, and

Young, had ever observed any circumstance that made them in the least *suspect* what was going on.

To such a close planned act of villany, my mind being entirely free from any suspicion, it is not wonderful that I felt a sacrifice. Had their mutiny been occasioned by any grievances, either real or imaginary, I must have discovered symptoms of their discontent, which would have put me on my guard: but the case was far otherwise. I slept with the door of my cabin always open, that the officer of the watch might have access to me on all occasions, the possibility of such a conspiracy being ever the farthest from my thoughts. CHRISTIAN, in particular, I was on the most friendly terms with: that very day he was to have dined with me; and the preceding night he excused himself from supping with me on pretence of being unwell; for which I felt concerned, having no suspicion of his integrity and honour.

Fortunately it was calm all the afternoon, till about four o'clock, when we were so far to windward, that, with a moderate easterly breeze which sprung up, we were able to sail. It was nevertheless dark when we got to *Tofoa*, where I expected to land to seek a supply of bread-

bread-fruit and water. But the shore proved to be so steep and rocky, that we were obliged to give up all thoughts of it, and keep the boat under the lee of the island with two oars: for there was no anchorage. Having fixed on this mode of proceeding for the night, I served to every person half a pint of grog, and each took to his rest as well as our unhappy situation would allow.

WEDNESDAY, APRIL 29. In the morning, at dawn of day, we rowed along shore in search of a landing place, and about ten o'clock we discovered a cove with a stony beach, at the NW part of the island, where I dropt the grapnel within 20 yards of the rocks. A great surf ran on the shore; but, as I was unwilling to diminish our stock of provisions, I landed Mr. SAMUEL, who climbed the cliffs, and got into the country in search of supplies. It was great consolation to me to find, that the spirits of my people did not sink, notwithstanding our miserable and almost hopeless situation. Towards noon Mr. SAMUEL returned, with a few quarts of water which he had found in holes; but he had met with no spring, or any prospect of a sufficient supply in that particular, and had seen only the signs of inhabitants,

inhabitants. As it was uncertain what might be our future necessities, I only issued a morsel of bread, and a glass of wine, to each person for dinner.

At day-light, we attempted to put to sea; but the wind and weather proved so bad, that I was glad to return to our former station near the cove; where, after issuing a morsel of bread and a spoonful of rum to each person, we landed, and I went off with Mr. NELSON, Mr. SAMUEL, and some others, into the country in search of provisions.

We found a few deserted huts, and a small plantain walk, from which we collected three small branches of plantains. After passing this place, we came to a deep gully that led towards a mountain, near a *volcano*; and, as I conceived that in the rainy season very great torrents of water must pass through it, we hoped to find sufficient for our use remaining in some holes of the rocks; but, after all our search, the whole that we collected was only nine gallons. We advanced within two miles of the foot of the highest mountain in the island, on which is the volcano, which is almost constantly burning. The country near it is covered with *lava*, and has a most dreary appearance. As we had not been fortunate in our discoveries, and saw nothing to alleviate our distresses,

trefs, except the plantains and water above mentioned, we returned to the boat exceedingly fatigued and faint. Every person being returned by noon, I gave about an ounce of pork and two plantains to each, with half a glass of wine. The people who remained with the boat I had directed to look for fish, or what they could pick up about the rocks; but nothing eatable could be found: so that, upon the whole, we considered ourselves on as miserable a spot of land as could well be imagined.

About two o'clock in the afternoon another party set out; but, after suffering much fatigue, they returned in the evening without any kind of success.

At the head of the cove, about 150 yards from the water side, there was a *cave*. This situation secured us from the danger of being surpris'd, and I determin'd to remain on shore for the night, with a part of my people, that the others might have more room to rest in the boat with the master; whom I directed to be watchful, in case we should be attacked. I ordered one plantain for each person to be boiled; and having supped on this scanty allowance, with a quarter of a pint of grog, and fix'd the watches for the night, those whose turn it was laid down to sleep in the cave, before which we kept up  
a good



a good fire, notwithstanding which we were much troubled with flies and musquitoes.

FRIDAY, MAY 1. At dawn of day, a party was sent out by a different route, to see what they could procure. They however only met with two men, a woman, and a child, who accompanied them to the cove with two cocoa-nut shells of water. I endeavoured to make friends of these people, and sent them away for bread-fruit, plantains, and water. Soon after other natives came to us; and by noon there were thirty about us, from whom we obtained a small supply; but I could only afford one ounce of pork, and a quarter of a bread-fruit, to each man for dinner, with half a pint of water; for I was fixed in my resolution not to use, as yet, any of the bread or water in the boat.

Some of the natives were coming and going the whole afternoon, and we got enough of bread-fruit, plantains, and cocoa nuts, for another day; but of water they only brought us about five pints. A canoe also came to us with four men, and brought a few cocoa-nuts and bread-fruit, which I bought with buttons and a few beads as I had done the rest.

Towards evening, I had the satisfaction to find our stock of provisions somewhat increased. At sun-set all



the natives left us in quiet possession of the cave. I thought this a good sign, and made no doubt that they would come again next day with a better supply of food and water, and we should obtain sufficient to stock us for our intended voyage.

At night, I served a quarter of a bread-fruit and a cocoa-nut to each person for supper; and, a good fire being made, all but the watch went to sleep.

At day-break, next morning, I was pleased to find every one's spirits a little revived, and that they no longer regarded me with those anxious looks, which had constantly been directed towards me since we lost sight of the ship: every countenance appeared to have a degree of cheerfulness, and they all seemed determined to do their utmost.

As there was no direct certainty of our being supplied with water by the natives, I sent a party among the gullies in the mountains, with empty shells, to see what could be found. In their absence the natives came about us, as I expected, and in greater numbers; two canoes also came in from round the north side of the island. In one of them was an elderly chief. Soon after, some of our foraging party returned, and with them came Erow, a chief. To each of these men I made a present of an old

old shirt and a knife. They were very inquisitive to know in what manner I had lost my ship. During this conversation, a young man, named NAGETE, appeared, whom I remembered to have seen in 1777: he expressed much pleasure at our meeting. The goodwill and affability of this man gave me much satisfaction.

This, however, was but of short duration, for the natives began to increase in number, and I observed some symptoms of a design against us. Soon after they attempted to haul the boat on shore, on which I brandished my cutlass in a threatening manner, and spoke to Erow to order them to desist; which they did, and every thing became quiet again. As we had no means of improving our situation, I told our people I would wait till sun-set, by which time, perhaps, something might happen in our favour: for if we attempted to go at present, we must fight our way through, which we could do more advantageously at night; and that in the mean time we should endeavour to get off to the boat what we had bought.

The beach was lined with the natives, and we heard nothing but the knocking of stones together, which

they had in each hand. I knew very well this was the sign of an attack. They frequently importuned me to sit down, but I as constantly refused: for it occurred both to NELSON and myself, that they intended to seize hold of me, if I gave them such an opportunity. At noon I served a cocoa-nut and a bread-fruit to each person for dinner, and gave some to the chiefs, with whom I continued to appear intimate and friendly. Keeping, therefore, constantly on our guard, we were suffered to eat our uncomfortable meal in some quietness.

After dinner we began by little and little to get our things into the boat, which was a troublesome business, on account of the surf. I carefully watched the motions of the natives, who continued to increase in number; and found that, instead of their intention being to leave us, fires were made, and places fixed on for their stay during the night. Consultations were also held among them, and every thing assured me we should be attacked. I sent orders to the master, that when he saw us coming down, he should keep the boat close to the shore, that we might the more readily embark, and in sending this paper down to the boat, it was nearly *snatched away*, but for the timely assistance of the gunner.

When

When the sun began to set, I gave the word, on which every person who was on shore with me boldly took up his proportion of things, and carried them to the boat.

The chiefs eagerly asked of me, if I did not intend sleeping in the cave as on the preceding night. I said, “No; but in the morning we will again trade with you, and I shall remain till the weather is moderate, when we go, as we have agreed, to *Tongataboo*.”

The elder chief then started up, and said, “You will not sleep on shore, then *mattie*,” which means, we will kill you instantly, and he left us.

The onset was now prepared. Every one made a noise with the stones he held in his hand, and EFOW ran from us.

All but two or three things were in the boat, when I took NAGETE by the hand, and our people walked down the beach, every one in a silent kind of horror.

While I was seeing them embark, NAGETE requested me to have a conference with EFOW; but I found EFOW was encouraging them to make the instant attack, and it was my determination, if they had *then* began, to have killed NAGETE, for his treacherous behaviour. I ordered the carpenter not to quit me till the other people were in the boat. NAGETE, finding I would

would not stay, violently loosed himself from my hold, and ran off, and we all got into the boat except one man, who, while I was getting on board, quitted it, and with undaunted bravery ran up the beach to cast the stern-fast off, notwithstanding the master and others called on him to return, while they were hauling me out of the water.

I was no sooner in the boat than the attack was begun by about *two hundred men*; the unfortunate sailor who had run up the beach was knocked down, and the stones flew like a shower of shot. Many Indians got hold of the stern-rope, and were near hauling the boat on shore; which they would certainly have effected, if I had not had a knife in my pocket, with which I cut the rope. At this time I saw five of the natives about the poor man they had killed, and two of them were beating him about the head with stones in their hands.

We had no time to reflect, for, to my surprise, they filled their canoes with stones, and twelve men came off after us to renew the attack, which they did so effectually as nearly to disable us all. Our grapnel was foul, but fortunately the fluke broke, and we got to our oars, and pulled to sea. They, however, could paddle round us, so that we were obliged to sustain the attack without  
being



being able to return it, except with such stones as lodged in the boat; and in this I found we were very inferior to them. We could not close, because our boat was lumbered and heavy, of which they well knew how to take advantage: I therefore adopted the expedient of throwing overboard some clothes, which, as I expected, they stopped to pick up; and, as it was by this time almost dark, they gave over the attack, and returned towards the shore, leaving us to meditate on our unhappy situation.

The poor man killed by the natives was John NORTON: this was his second voyage with me as quartermaster, and his worthy character made me lament his loss very much. He has left an aged parent, I am told, whom he supported.

Taking this as a sample of the disposition of the natives, there was but little reason to expect much benefit by persevering in the intention of visiting *Tongataboo*; for I considered their good behaviour formerly to have proceeded, like that of these people, from a dread of our fire arms, and which, therefore, was likely to cease as soon as they knew we were destitute of them: and, even supposing they would not destroy us, the boat, and every thing we had which they considered of value,



would most probably be taken from us, and thereby all hopes precluded of ever being able to revisit our native country.

We therefore set our sails, and steered along shore by the west side of the island *Tofa*; the wind blowing fresh from the eastward.

My mind was now busily employed in considering what was best to be done, when I was solicited by all hands to take them towards home:—and when I told them that no hopes of relief remained for us (except what might be found at *New Holland*) till I came to TIMOR, a distance of full 1200 leagues, where there was a Dutch settlement, but in what part of the island I knew not,—to effect which, they all agreed to live on *one ounce of bread, and a quarter of a pint of water per day*. Therefore, after examining our stock of provisions, and recommending to them, in the most solemn manner, not to depart from their promise, we bore away across a sea, where the navigation is but little known, in a small boat, twenty-three feet long from stem to stern deep laden with *eighteen men*. I was happy, however, to see that every one seemed better satisfied with our situation than myself.

Our stock of provisions consisted of about one hundred  
and

and fifty pounds of bread, twenty-eight gallons of water, twenty pounds of pork, three bottles of wine, and five quarts of rum. A few cocoa-nuts were in the boat, and some bread-fruit, but the latter was trampled to pieces.

It was about eight o'clock at night when we bore away under a reefed lug fore-fail : and, having divided the people into watches, and got the boat in a little order, we returned God thanks for our miraculous preservation, and, fully confident of his gracious support, I found my mind more at ease than it had been for some time past.

At day-break the gale increased; the sun rose very fiery and red, a sure indication of a severe gale of wind. At eight it blew a violent storm, and the sea ran very high, so that between the seas the fail was becalmed, and when on the top of the sea it was too much to have set but we could not venture to take in the fail, for we were in very imminent danger and distress, the sea curled over the stern of the boat, which obliged us to bale with all our might. A situation more distressing has, perhaps, seldom been experienced.

Our bread was in bags, and likely to be spoiled by the wet: to be starved to death was inevitable, if this could

not be prevented. Fortunately for us we had on board the carpenter's chest, the tools of which we stowed at the bottom of the boat, and it became a fit place to secure this article.

I next began to examine what clothes there were in the boat, and what other things could be spared; and, having determined the quantity to be kept, the rest was thrown overboard, with some rope and spare sails, which lightened the boat considerably, and we had more room to bale the water out.

I served a tea spoonful of rum to each person (for we were very wet and cold), with a quarter of a bread-fruit, which was scarce eatable, for dinner:—our engagement was now strictly to be carried into execution, and I was fully determined to make our provisions last eight weeks, let the daily proportion be ever so small.

The weather continued very severe. The sea ran higher than in the forenoon, and the fatigue of bailing, to keep the boat from filling, was exceedingly great. But among the hardships we were to undergo, that of being constantly wet was not the least: the night was very cold, and at day-light our limbs were so benumbed, that we could scarce find the use of them. At this

time I served a *tea-spoonful* of *rum* to each person, FROM WHICH WE ALL FOUND GREAT BENEFIT !

MONDAY, MAY 4. I divided five small cocoa nuts for our dinner, and every one seemed satisfied. Served for supper a few broken pieces of bread-fruit, and performed prayers.

The night turned out fair, and, having had tolerable rest, every one seemed considerably better in the morning, and contentedly breakfasted on a few pieces of yams that were found in the boat. After breakfast we examined our bread, a great deal of which was damaged and rotten ; this, nevertheless, we were glad to keep for use.

For dinner, I served some of the damaged bread, and a quarter of a pint of water.

WEDNESDAY, MAY 6. We discovered several small islands. Those we were near appeared fruitful and hilly, some very mountainous, and all of a great height. I durst not, however, venture to land, as we had no arms, and were less capable of defending ourselves than we were at *Tofoa*.

Our allowance for the day was a quarter of a pint of cocoa-nut milk, and the meat, which did not exceed

3 X 2

two

two ounces to each person : it was received very contentedly, but we suffered great drought.

To our great joy we hooked a fish, but we were miserably disappointed by its being lost in trying to get it into the boat.

I directed the course W. by N. for the night, and served to each person an ounce of the damaged bread, and a quarter of a pint of water, for supper.

As our lodgings were very miserable, and confined for want of room, I endeavoured to remedy the latter defect, by putting ourselves to watch and watch ; so that one half always sat up while the other lay down on the boat's bottom, or upon a chest exposed to the open air.

Our limbs were dreadfully cramped, for we could not stretch them out ; and the nights were so cold, and we so constantly wet, that, after a few hours sleep, we could scarce move.

THURSDAY, MAY 7. At dawn of day we discovered land. The country appeared to be agreeably interspersed with high and low land, and in some places covered with wood.

Being very wet and cold, I served a spoonful of rum  
and

and a morsel of bread for breakfast. At this time we observed two large sailing canoes coming swiftly after us along shore, and, being apprehensive of their intentions, we rowed with some anxiety, fully sensible of our weak and defenceless state. Only one of them gained upon us, which, however, by three o'clock in the afternoon gave over chase. If I may judge from the fail of these vessels, they are of a similar construction with those at the *Friendly Islands*, which, with their situation, gives reason to believe they are the same kind of people. Whether these canoes had any hostile intention against us must remain a doubt: perhaps we might have benefited by an intercourse with them; but in our defenceless situation, to have made the experiment would have been risking too much.

At four o'clock there was much thunder and lightning, and heavy rain, when every person did his utmost to catch some water, and we increased our stock to 34 gallons, besides quenching our thirst for the first time since we had been at sea; but we passed the night very miserably, for being extremely wet, and having no dry things to shift or cover us, we experienced cold and shiverings scarce to be conceived.

FRIDAY, MAY 8. The allowance I issued to-day,

was



was an ounce and a half of pork, a *tea-spoonful* of *rum*, half a pint of cocoa-nut milk, and an ounce of bread. THE RUM, THOUGH SO SMALL IN QUANTITY, WAS OF THE GREATEST SERVICE! For supper I served a quarter of a pint of water, and half an ounce of bread. I endeavoured to amuse my people by describing the situation of *New Guinea* and *New Holland*, and gave them every information in my power, that in case any accident happened to me, those who survived might have some idea of what they were about, and be able to find their way to TIMOR, which at present they knew nothing of but the name.

SATURDAY, MAY 9. In the morning, a quarter of a pint of cocoa-nut milk, and some of the decayed bread, was served for breakfast; and for dinner I divided the meat of four cocoa-nuts, with the remainder of the rotten bread, which was only eatable by such distressed people. The wind had been moderate all day, in the SE. quarter, with fine weather; but, about nine o'clock in the evening, the clouds began to gather, and we had a prodigious fall of rain, with severe thunder and lightning. Being miserably wet and cold, I served to the people a *tea-spoonful* of *rum* each, to enable them to bear their distressed situation. The weather continued  
extremely

extremely bad, and the wind increased; we spent a very miserable night, without sleep, except such as could be got in the midst of rain.

SUNDAY, MAY 10. The day brought no relief but its light. The sea broke over us so much, that two men were constantly baling; and we had no choice how to steer, being obliged to keep before the waves for fear of the boat filling.

The *allowance* now regularly served to each person, was *one 25th of a pound of bread, and a quarter of a pint of water, at eight in the morning, at noon, and at sun-set.*

To-day I gave about half an ounce of pork for dinner, which, though any one would have considered only as a mouthful, was divided into several pieces, and was eat with great slowness.

A fishing line was generally towing from the stern of the boat, but though we saw great numbers of fish, we could never catch one.

The rain abated towards noon, but the wind continued very strong, with very squally weather, and a high breaking sea, so that we were miserably wet, and suffered great cold in the night.

MONDAY, MAY 11. In the morning at day-break,

I served

I served to every person a *tea-spoonful* of *rum*, our limbs being so cramped that we could scarce move them. Our situation was now extremely dangerous, the sea frequently running over our stern, which kept us baling with all our strength. In the evening it rained hard, and we again experienced a dreadful night.

TUESDAY, MAY 12. At length the day came, and shewed to me a miserable set of beings, full of wants, without any thing to relieve them.

Some complained of great pain in the bowels, and every one of having almost lost the entire use of his limbs.

The little sleep we got was no ways refreshing, as we were covered with sea and rain.

I served a *spoonful* of *rum* at day-dawn, and measured out the 25th of a pound of bread, and a quarter of a pint of water, as yesterday.

The wet weather continued, and in the afternoon the wind came from the southward, blowing fresh in squalls. As there was no prospect of getting our clothes dried, I recommended to every one to strip, and wring them through the salt water, by which means they received a warmth which, when wet with rain, they had not.

WEDNESDAY,

WEDNESDAY, MAY 13. I thought it prudent to keep back the allowance of rum at day-break. All this day, we were constantly shipping water, and baling, and suffered much cold and shiverings in the night.

THURSDAY, MAY 14. Fresh gales at SE. and gloomy weather, with rain, and a high sea. At six in the morning we saw land, which soon appeared to be four islands, one of them larger than the others, and all of them high and remarkable in appearance\*.

FRIDAY, MAY 15. At one in the morning another island was discovered. A number of grunnets, boobies, and men of war birds were seen. These islands lie between the latitude  $13^{\circ} 16'$  and  $14^{\circ} 10'$  S.; their longitude, according to my reckoning,  $15^{\circ} 51'$  to  $17^{\circ} 6'$  W. from the island *Tofoa*; that is  $167^{\circ} 17'$  E. to  $168^{\circ} 34'$  E. from *Greenwich*. The largest island I judged to be about twenty leagues in circuit, the others five or six. The easternmost is the smallest island, and most remarkable, having a high sugar-loaf hill. They are fertile, and inhabited, as I saw smoke in several places.

The sight of these islands served only to increase the misery of our situation. We were very little better than starving, with plenty in view; yet to attempt pro-

\* These were new discoveries.

curing any relief was attended with so much danger, that prolonging of life, even in the midst of misery, was thought preferable, while there remained hopes of being able to surmount our hardships.

The wind was at SE. with rainy weather all day. The night was very dark, not a star could be seen to steer by, and the sea broke continually over us.

SATURDAY, MAY 16. In addition to our miserable allowance of one 25th of a pound of bread, and a quarter of a pint of water, I issued for dinner about an ounce of salt pork to each person. I was often solicited for this pork, but I considered it more proper to issue it in small quantities, than to suffer it to be all used at once or twice, which would have been done if I had allowed it.

The sun breaking through the clouds, gave us hopes of drying our wet clothes; but the sunshine was of short duration. We had strong breezes at SE. by S. and dark gloomy weather, with storms of thunder, lightning, and rain. The night was truly horrible, and not a star to be seen; so that our steerage was uncertain.

SUNDAY, MAY 17. At dawn of day, I found every person complaining, and some of them solicited *extra al-*

*lowance*; which I positively refused. The night was dark and dismal; the sea constantly breaking over us, and nothing but the wind and waves to direct our steering. *The little rum we had was of great service*: for when our nights were particularly distressing, I generally served a *tea-spoonful* or *two* to each person: and it was always *joyful tidings* when they heard of my intentions.

MONDAY, MAY 18. In the morning the rain abated. The customary allowance of one 25th of a pound of bread, and a quarter of a pint of water, was served at breakfast, dinner, and supper. In the night, we had very severe lightning, with heavy rains; and were obliged to keep baling without intermission.

TUESDAY, MAY 19. Very bad weather and constant rain. With the allowance of bread and water, served half an ounce of pork to each person for dinner.

WEDNESDAY, May 20. Fresh breezes with constant rain; at times a deluge. Always baling. At dawn of day, some of my people seemed half dead: our appearances were horrible; and I could look no way, but I caught the eye of some one in distress. *Extreme hunger* was now too evident, but no one suffered from thirst. The little sleep we got was in the midst of



water, and we constantly awoke with severe cramps and pain in our bones. This morning I served about *two tea spoonfuls* of rum to each person, and the allowance of bread and water, as usual. All the afternoon we were so covered with rain and salt water, that we could scarcely see. We suffered extreme cold, and every one dreaded the approach of night. Sleep, though we longed for it, *afforded no relief*: for my own part, *I almost lived without it*. About two o'clock in the morning we were overwhelmed with a deluge of rain. It fell so heavy that we were afraid it would fill the boat, and were obliged to bale with all our might.

THURSDAY, MAY 21. At dawn of day I served a *larger allowance* of rum. Towards noon the rain abated and the sun shone; but we were miserably cold and wet, the sea breaking constantly over us; so that, notwithstanding the heavy rain, we had not been able to add to our stock of fresh water.

FRIDAY, MAY 22. Our situation this day was extremely calamitous. We were obliged to take the course of the sea, running right before it, and watching with the utmost care, as the least error in the helm would in a moment have been our destruction. At noon it blew very hard, and the foam of the sea kept running over

our

our stern and quarters. The misery we suffered this night exceeded the preceding. The sea flew over us with great force, and kept us baling with horror and anxiety.

SATURDAY, MAY 23. At dawn of day I found every one in a most distressed condition, and I began to fear that another such night would put an end to the lives of several, who seemed no longer able to support their sufferings.

I served an allowance of *two tea-spoonfuls* of rum; after drinking which, having wrung our clothes, and taken our breakfast of bread and water, we became a little refreshed.

SUNDAY, MAY 24. With the usual allowance of bread and water for dinner, I served an ounce of pork to each person. This afternoon we had many birds about us, which are never seen far from land, such as *boobies* and *noddies*. As the sun for the first time for fifteen days shone bright, and the sea was calmed, so that we shipped but little water, I took the opportunity to examine into the state of our bread, and found, that according to the present mode of issuing, there was a sufficient quantity remaining for 29 days allowance; by which time I hoped we should be able to reach TIMOR.

But

But as this was uncertain, I determined to proportion the allowance so as to make our stock hold out six weeks.

I was apprehensive that this would be ill received, and that it would require my utmost resolution to enforce it; for, small as the quantity was which I intended to take away, for our future good, yet it might appear to my people like robbing them of life; and some, who were less patient than their companions, I expected would very ill brook it. However, on my representing the necessity of guarding against delays that might be occasioned in our voyage by contrary winds, or other causes, and promising to enlarge upon the allowance as we got on, they cheerfully agreed to my proposal. It was accordingly settled, that every person should receive one 25th of a pound of bread for breakfast, and the same quantity for dinner; so that by omitting the proportion for supper, we had 43 days allowance.

MONDAY, MAY 25. At noon some *noddies* came so near to us, that one of them was *caught* by the hand. This bird is the size of a pigeon. I divided it, with its entrails, into 18 portions, and it was distributed with the allowance of bread and water for dinner, and we eat up bones and all, with salt water for sauce. In the evening,

evening, several *boobies* flying very near to us, we had the good fortune to *catch* one of them. This bird is as large as a duck : like the noddy, it has received its name from seamen, for suffering itself to be caught on the masts and yards of ships. I directed the bird to be killed for supper, and the body, with the entrails, beak, and feet, I divided into 18 shares, and with an allowance of bread, considering all circumstances, we seemed to make a tolerable supper.

TUESDAY, MAY 26. Fresh breezes from the SE. with fine weather. In the morning we caught another booby, so that PROVIDENCE appeared to be relieving our wants in an extraordinary manner. My people were overjoyed at the addition to their dinner, which was distributed in the same manner as on the preceding evening, *Who shall have this?*

The weather was now serene, which, nevertheless, was not without its inconveniences, for we began to feel distress of a different kind from that which we had lately been accustomed to suffer. The heat of the sun occasioned several of our people to be seized with such languor and faintness, that life seemed intolerable. We complained all of dizziness in the head, great weakness of the joints, and violent tenesmus; most of us having  
had

had no evacuation \* by stool since we left the ship. I had constantly a severe pain at my stomach ; but none of our complaints were alarming : on the contrary, every one retained marks of strength, that, with a mind possessed of a tolerable share of fortitude, seemed able to bear still greater fatigue.

MAY 29. We reached the coast of *New Holland*, and the joy of my men at the prospect of finding something on the shore was excessive. We returned God thanks for his gracious protection, and with much content took our miserable allowance of a 25th of a pound of bread, and a quarter of a pint of water, for dinner.

As there were no appearances to make me imagine any of the natives were near us, I sent out parties in search of supplies, while others of the people were put-

\* It was so in the case of Betsy CANNING, who being confined, because she would not prostitute herself, three weeks in a loft by a gipsy woman, lived during that time upon a crust of bread and a small pitcher of water, and escaped in a most wretched condition. Other circumstances also confirm the truth of her story. It seems to prove that the bile is not the only stimulus wanted to forward the peristaltic motion of the bowels. There are some physicians (vide SHEBBEAR'S *Practice of Physic*) who believe it bears but a slight part, and upon trying experiments with animals, they find, that its natural motions are very slow, and depend almost entirely on the operation of other stimuli, and are quick in proportion to the force of these, as is exemplified by rhubarb, jalap, salts, &c. This subject deserves further attention.

ting the boat in order, that we might be ready to go to sea in case any unforeseen cause should make it necessary.

The parties returned, highly rejoiced at having found plenty of oysters and fresh water. They had made a fire by the help of a small magnifying glass; and what was still more fortunate, we found, among the few things which had been thrown into the boat and saved, a piece of brimstone and a tinder-box, so that I secured fire for the future.

THE SYMPTOMS OF HAVING EAT TOO MUCH BEGAN TO FRIGHTEN SOME OF US; BUT ON QUESTIONING OTHERS, WHO HAD TAKEN A MORE MODERATE ALLOWANCE, THEIR MINDS WERE A LITTLE QUIETED. THE OTHERS, HOWEVER, BECAME EQUALLY ALARMED IN THEIR TURN, DREADING THAT SUCH SYMPTOMS (*which resembled intoxication*) WOULD COME ON, AND THAT THEY WERE ALL POISONED, SO THAT THEY REGARDED EACH OTHER WITH THE STRONGEST MARKS OF APPREHENSION, UNCERTAIN WHAT WOULD BE THE ISSUE OF THEIR IMPRUDENCE. FORTUNATELY THE FRUITS WE OBTAINED HERE PROVED WHOLESOME AND GOOD, OF WHICH I WAS SOON PER-



SUADED, WHEN I SAW THE BIRDS EAT THEM WITHOUT EXPERIENCING ANY HURT \*.

SATURDAY, MAY 30. In the morning I discovered a visible alteration in our company for the better, and I sent them away again to gather oysters. We had 38 days allowance, according to the last mode of issuing the 25th of a pound at breakfast and at dinner, and two pounds of pork left. This article, which I did not keep under lock and key as I did the bread, had been pilfered by some *inconsiderate person*, but every one denied having any knowledge of this act; I therefore resolved to put it out of their power for the future, by sharing what remained for our dinner.

While the party was out picking up oysters, I got the boat in readiness for sea, and filled all our water-vessels, which amounted to nearly 60 gallons. On this occasion, fatigue and weakness so far got the better of their sense of duty, that some of the people expressed their discontent at having worked harder than their

\* This is a strong evidence of accumulated irritability in the fibre, vide page 546. Persons, says Dr. BEDDOES, who have been shut up in a coal-work from the falling in of the sides of a pit, and have had nothing to eat for four or five days, will be as much intoxicated by a basin of broth, as an ordinary person by three or four quarts of strong beer.

companions, and declared that they would rather be without their dinner than go in search of it. One person, in particular, went so far as to tell me, with a mutinous look, that "he was as good a man as myself." It was not possible for me to judge where this might have an end, if not stopped in time; therefore, to prevent such disputes in future, I determined either to preserve my command, or die in the attempt: and, seizing a cutlass, I ordered him to take hold of another and defend himself; on which he called out I was going to kill him, and humbly implored forgiveness. I did not allow this to interfere further with the harmony of the boat's crew, and every thing soon became quiet.

JUNE 1. NELSON, who had been out with others in search of provisions, was obliged to be brought back, supported by two men. His complaint was a violent heat in his bowels, a loss of sight, much drought, and an almost total inability to walk. This I found was occasioned by his being unable to support the heat of the sun, and his attempting to do more than his strength was equal to. It was now that the little wine, which I had so carefully saved, became of real use. I gave it in very small quantities, with some pieces of bread soaked in it; and he soon began to recover. The boatswain

and carpenter also were ill, and complained of head-ach, and sickness of the stomach.

Towards evening I cautioned every one against making too large a fire, or suffering it after dark to blaze up. Mr. SAMUEL had the superintendence of this business, while I was strolling about the beach to observe if I thought it could be seen from the main. I was just satisfied that it could not, when on a sudden the whole country appeared in a blaze, that might have been discerned at a much more considerable distance. I ran to learn the cause, found that it was occasioned by the obstinacy and imprudence of one of the party, who, in my absence, had insisted on increasing the fire, in doing which the flames caught the neighbouring grass, and rapidly spread. This misconduct might have produced very serious consequences, by discovering our situation to the natives; for, if they had attacked us, we had neither arms nor strength to oppose an enemy. Thus the relief which I expected from a little sleep on shore was totally lost, and I anxiously waited for the flowing of the tide, that we might proceed to sea.

We had now remained just six days on the coast of *New Holland*, where we found oysters, a few clams,  
some

some small fruits, birds\*, and water. But perhaps a benefit nearly equal to this we received, by having been relieved from the irksomeness of being constantly in a crowded boat, and by obtaining good rest at night.

These advantages certainly preserved our lives; and, small as the supply was, I am very sensible how much it alleviated our distresses. By this time nature would have sunk under the extremes of hunger and fatigue. Some would have ceased to struggle for a life that only promised wretchedness and misery; and others, though possessed of more bodily strength, must soon have followed their unfortunate companions. Even in our present situation, we were most deplorable objects; but the hopes of a speedy relief kept up our spirits. I was secretly surprised to see that my men seemed as if they had embarked on a voyage to TIMOR in a vessel calculated for safety and convenience. So much *confidence* gave me great pleasure, and I may venture to assert, that to *this cause* our preservation is chiefly to be attributed. For my own part, incredible as it may appear,

\* Robert Lamb, when he came to Java, acknowledged that, in one of the foraging parties, he had separated from his companions, and had eat nine birds raw, which he had caught.

I FELT NEITHER EXTREME HUNGER NOR THIRST \*.  
My allowance contented me, knowing that I could have no more.

JUNE 4. We were now launched into the open ocean, and I served one 25th of a pound of bread, and an allowance of water, for breakfast, and the same for dinner, with an addition of six oysters to each person.

JUNE 5. Six oysters were, as yesterday, served to each man, in addition to the usual allowance of bread and water. In the evening, a few boobies came about us, one of which I caught with my hand. With the allowance of bread I served a quarter of a pint of water for supper, and to some, who were most in need, half a pint. In the course of the night, being constantly wet with the sea, we suffered much cold and shiverings.

JUNE 6. At day-light I found that some of the clams, which had been hung up to dry for sea store, were stolen; but every one solemnly denied having any knowledge of it. In the afternoon, I took an opportunity of examining our store of bread, and found re-

\* Vide page 546.

maining 19 days allowance, at the former rate of serving one 25th of a pound three times a day : therefore, as I saw every prospect of a quick passage, I again ventured to grant an allowance for supper, agreeable to my promise at the time it was discontinued.

JUNE 7. We had passed the night miserably wet and cold, and in the morning I heard nothing but heavy complaints. The sea was high and breaking over us. I could only afford the allowance of bread and water for breakfast ; but for dinner I gave out an ounce of dried clams to each person, which was all that remained. The sea ran very high all this day, and we had frequent showers of rain, so that we were continually wet, and suffered much cold in the night.

Mr. LEDWARD, the surgeon, and Lawrence LE-BÂGUE, an old hardy seaman, appeared to be giving way very fast. I could only assist them by a tea-spoonful or two of wine, which I had carefully saved, expecting such a melancholy necessity.

At four in the afternoon, we caught a small dolphin, which was the first relief of the kind that we obtained. I issued out two ounces to each person, including the offals, and saved the remainder for dinner the next day.

Towards



Towards evening the wind freshened, and it blew strong all night, so that we shipped much water, and suffered greatly from the wet and cold.

JUNE 9. At day-light, as usual, I heard much complaining, which my own feelings convinced me was too well founded. Served the usual allowance of bread and water, and at noon we dined on the remains of the dolphin, which amounted to an ounce per man. This afternoon I suffered great sickness from having the stomach of the fish, which had fallen to my share at dinner. At sun-set I served an allowance of bread and water for supper.

JUNE 10. In the morning, after a very comfortable night, there was a visible alteration for the worse in many of the people; which gave me great apprehensions.

*An extreme weakness, swelled legs, hollow and ghastly countenances, A MORE THAN COMMON INCLINATION TO SLEEP, with an apparent debility of understanding, seemed the melancholy presages of approaching dissolution.*

The surgeon and LABOGUE, in particular, were most miserable objects. I occasionally gave them a few *teaspoonfuls of wine*, out of the little that remained, which greatly assisted them. Gannets, boobies, men of war birds,

birds, were constantly about us. I encouraged the men with the hopes of a very few days longer, at the present fine rate of sailing, and we should reach TIMOR. This expectation was our principal support.

JUNE 11. Every one received the accustomed allowance of bread and water, and an extra allowance of water was given to those who were most in need. In the afternoon we saw gannets, and many other birds, and at sun-set we kept a very anxious look out. In the evening we caught a booby, which I reserved for our dinner the next day.

FRIDAY, JUNE 12. At three in the morning, with an excess of joy, we discovered TIMOR, bearing WNW.

It is not possible for me to describe the pleasure which the blessing of the sight of this land diffused among us. It appeared scarce credible to ourselves, that in an open boat, and so poorly provided, we should have been able to reach the coast of TIMOR in 41 days after leaving TOFOA, having in that time run, by our log, a distance of *three thousand, six hundred, and eighteen miles*; and that, notwithstanding our extreme distress, no one should have perished in the voyage.

The day gave us a most agreeable prospect of the  
VOL. III. 4 A land,

land, which was interspersed with woods and lawns ; the interior part mountainous, but the shore low. Towards noon the coast became higher, with some remarkable headlands. We were much delighted with the general look of the country, which exhibited many cultivated spots and beautiful situations ; but we could only see a few small huts, whence I concluded that no European resided in this part of the island. Much sea ran on the shore, which made landing impracticable.

JUNE 13. Not perceiving any sign of settlement, we bore away to the westward, steering along shore. We had a view of a beautiful looking country, as if formed by art into lawns and parks. At two o'clock, having run through a very dangerous breaking sea, the cause of which I attributed to a strong tide setting to windward, and shoal water, we discovered a spacious bay or sound, with a fair entrance about two or three miles wide. I came to a grapnel near the east side of the entrance, in a small sandy bay, where we saw a hut, a dog, and some cattle ; and I immediately sent the boatswain and gunner away to the hut, to discover the inhabitants.

They returned with five Indians, and informed me that they had found two black families, where the women

men treated them with European politeness. They brought us a few pieces of dried turtle, and some ears of Indian corn, and offered to fetch us some other refreshments if I would wait : but we determined to push on.

We kept close to the east shore under all our sail ; but, as night came on, the wind died away, and we were obliged to try at the oars, which I was surprised to see we could use with some effect.

SUNDAY, JUNE 14. At one o'clock in the morning, after the most happy and sweet sleep that ever men enjoyed, we weighed, and continued to keep the east shore. The report of two cannon that were fired in the morning early gave new life to every one. We soon after discovered two square-rigged vessels and a cutter at anchor to the eastward. We endeavoured to work to windward, but were obliged to take to our oars again, having lost ground on each tack. At day-light we landed amidst a crowd of Indians, and were agreeably surprised to meet with an English sailor, who belonged to one of the vessels in the road.

The abilities of a painter, perhaps, could seldom have been displayed to more advantage, than in the delineation of the two groups of figures, which at this time

presented themselves to each other. An indifferent spectator would have been at a loss which most to admire; the eyes of famine sparkling at immediate relief, or the horror of their preservers at the sight of so many spectres, whose ghastly countenances, if the cause had been unknown, would rather have excited terror than pity. Our bodies were nothing but skin and bones, our limbs were full of sores, and we were clothed in rags: in this squalid condition, with the tears of joy and gratitude flowing down our cheeks, the people of TIMOR beheld us with a mixed sensation of horror, surprise, and pity.

They ran with eagerness to procure a surgeon to dress our wounds, to get apparel to cover our nakedness, and a place suitable for our reception. The governor, who was dying of an incurable disease, even hastened from his bed to welcome our arrival. People ran with chairs, tables, benches, and bedding, to an empty house that was assigned us. A plentiful dinner was soon laid before us: but for my own part I felt no extraordinary inclination to eat or drink. My mind kept musing on the mercy of ALMIGHTY GOD, who had made me the instrument of saving eighteen lives; and as I reflected how providentially we escaped at *Tofoa*, by the Indians  
 delaying

delaying their attack ; and that, with not more provisions than might have been consumed in five days, we crossed a sea of more than twelve hundred leagues, without shelter from the inclemency of the weather ; that in an open boat, with so much stormy weather, we escaped foundering ; that not any of us were taken off by disease ; that we had the great good fortune to pass the unfriendly natives of other countries without accident, and at last happily to meet with the most friendly and best people to relieve our distresses ;—I say, when I reflected on all these wonderful escapes, the remembrance of such great mercies enables me to bear, with resignation and cheerfulness, the failure of an expedition, the success of which I had so much at heart, and which was frustrated at a time when I was congratulating myself on the fairest prospect of being able to complete it in a manner that would fully have answered the intention of his Majesty, and the humane promoters of so benevolent a plan.

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That



That the state of Captain BLIGH and his company was that of ACCUMULATED IRRITABILITY, is strongly pointed out.

1st. From *one tea-spoonful* of rum producing on these poor men, benumbed as they were with cold, as much effect as *twenty times* the quantity would have on those who are warm and well fed. And indeed had it not been for the spirits having such a power to act upon men in their condition they never could have survived the hardships they experienced.

2dly. From the berries found in *New Holland* producing symptoms of *intoxication* \*, which would not have arisen under any other circumstances.

3dly. By the general *want* of *sleep* at first, and that which was obtained not refreshing; but, as with extreme cold, when the accumulation of irritability was such as to threaten the extinction of life, I observed, says this gallant officer, “ a more than  
“ common propensity to sleep †.”

\* Vide page 533.

† Vide page 540.

In the last campaign in India, when the Marquis CORNWALLIS was in possession of TIPPoo SULTAN's palace, and his gardens, at *Bangalore*, and was preparing to drive him from his capital, the indignant sultan expressed his ineffectual rage by the continual fire of cannon on our troops. As this display of his wrath could effect little, he came to Lieutenants CHALMERS and NASH, with the welcome tidings of an intended release, and requested them to take two letters on the subject of peace, which he said he had been very anxious to obtain ever since the commencement of the war. He presented them with two shawls each, and five hundred rupees, and ordered horses and attendants to go with them to the camp. He had at this very time concerted a scheme to destroy the commander in chief of our forces, whom he thought by this expedient to lull into a treacherous security. As our allies, the NIZAMS, had their army stationed at some small distance from ours, he ordered a party of horse to steal between the two armies, which affecting to belong to the NIZAM, asked our piquets for the *Burra Said*, or chief. Not suspecting them to be enemies, they pointed to his tent. These horsemen galloped immediately towards the tent, and having drawn their swords, cut down several lascars and people in their rout.

A party

A party of sepoys having turned out with alacrity, their progress was soon stopt. Some shots were fired at them as they retreated, but they got off however, having sustained very little loss.

This scheme, says Major DIRAM, was one of those daring projects that have been so frequently practised by the native powers against each other in effecting revolutions in the East: and had these assassins been conducted by a guide, or their judgment been equal to their spirit in the attempt, it is possible they might have effected their murderous project. But the *Mahomedan horse*, when sent upon such services, are kept *fasting*, and then intoxicated with *bang*, a plant mixed with their tobacco, of which they take a large dose before they enter upon so hazardous an enterprise. This inebriation renders their exertions so wild and disunited, that it is almost impossible for them ever to prove successful against a vigilant enemy.

It was thus in former days, when the Jesuits wanted any desperate act of wickedness to be done, having pitched upon their man, they would shut him up in a large chamber lighted with a small taper no bigger than one's little finger, and hung with black cloth, on which were painted hell flames and devils, and all manner of  
terrible

terrible shapes. This was called the chamber of meditation: and here the person was kept meditating and *fasting* for twenty-four hours; he was then-worked up to the pitch, at which his employers wanted him, by an *intoxicating draught*; and, shocking as it is to tell, it is nevertheless true, that the errand on which he was sometimes sent after this preparation was MURDER.

Perhaps, says Dr. PERCIVAL, in the case of SEXTIUS BACULUS, as recorded in the Commentaries of Cæsar, the extraordinary courage and prowess which he suddenly exerted, might be aided by the *exhilarating effect* of sustenance, which, under such circumstances, it is probable he would no longer decline. He had *fasted* several days: but hearing that the enemy was entering by the gate of the fortress, he *alone* resisted the combined efforts of a superior power, until the centurions, and others, came to his assistance, who took him away from the place of contest covered with wounds.

I have been informed, adds this eminent philosopher, by a young physician from *Geneva*, that, when he was student at *Montpelier*, he fasted three days and nights with no other refreshment than a pint of water daily. His hunger was keen, but never painful, during the first and second days of his abstinence; and on the third

day he perceived only a faintness; when he attempted either bodily or mental exertion. A sense of coldness was diffused over his whole frame, but more particularly affected the extremities. During the whole period the alvine exertions were suppressed\*, and at the close of it, his skin became tinged with a shade of yellow. The first food he took was *veal broth*, which had something of an *intoxicating effect*, producing a glow of warmth, and raising his spirits, so as to render him ashamed of his despondency.

HIPPOCRATES has very justly observed, that *children*, (who possess abundant irritability), are more affected by abstinence than young persons; *these* more than the middle aged; and the *middle aged* more than old men.

Agreeable to this aphorism, DANTE is said, by his countryman MORGAGNI, to have framed the incidents in the affecting story of Count UGOLINO, a nobleman of *Pisa*, who was confined, with his four sons, in the dungeon of a tower; the key of which being cast into the river *Arno*, they were, in this horrible situation, starved to death. And they are represented by the poet, as dying at different periods, according to their respective ages.

\* Vide page 532.

Now the fourth morning rose ; the youngest child  
 fell at his father's feet, in accent wild,  
 struggling with pain, with his last fleeting breath,  
 " *Help me, my fire,*" he cried, and sunk in death.  
 He saw the others follow one by one—  
 Heard their last scream,—and their expiring groan.

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In our attempts to recover those who have suffered under the calamities of FAMINE, great circumspection is required. Warmth, and cordials, are the means usually employed ; and it is evident that these may prove too powerful in their operation, if not administered with caution and judgment. For the body, by *long fasting*, as we have seen, is reduced to a state of *extreme irritability*; the minuter vessels of the brain, and of other organs, collapse for want of fluids to distend them ; the stomach and intestines shrink in their capacity ; and the pulsations of the heart and arteries are quick and feeble, with scarce sufficient energy to propel the scanty current of blood. Under such circumstances there are instances of persons who have been suddenly struck dead in consequence of having took a *full meal*, and drank a *glass* of brandy. As with those who have been *frost-bitten*, or *drowned*, friction with *snow* or *cold water*, is the only



safe *stimulus* that can at first be applied to the surface, so here the *lowest stimulus* in the scale is to be preferred to that *sudden transition* too often practised by *unphilosophic* practitioners. The external heat, says Dr. PERCIVAL, should be at first lower than that of the human body, and gradually increased, according to the effects of that stimulus. Whey, gruel, weak broth, is the only nourishment that can with propriety be administered. If cordials are employed, they should be given with the most frugal hand, and considerably diluted. Perhaps wine-whey might be better, and when the *superfluous irritability* is a little worn off, and the stomach strengthened, an egg may be mixed with the whey, or administered under some more agreeable form. But let it be remembered as an indubitable maxim, adds Dr. PERCIVAL, “ *that the return to a full diet should be conducted with great caution, and by very slow gradations.*”

## SECT. XLV.

## ON ASPHYXIA FROM COLD.

THE advantage of clothing, as fencing out the cold, or, in more philosophic language, as retaining the inbred, or vital, heat, has been before considered. We are now therefore to contemplate the effects of *extreme cold*.

Ah! little think the gay licentious proud,  
whom pleasure, power, and affluence surround;  
they, who their thoughtless hours in giddy mirth,  
and wanton, often cruel, riot waste.

Ah! little think they, while they dance along,  
how many feel, this very moment, death  
and all the sad variety of pain.

How many sink in the devouring flood,  
or more devouring flame. How many bleed,  
by shameful variance betwixt man and man.

How many pine in want, and dungeon-glooms;  
shut from the common air, and common use  
of their own limbs. How many drink the cup  
of baleful grief, or eat the bitter bread

of misery. Sore pierced by wintry winds,  
how many shrink into the sordid hut

of cheerless poverty.—Perhaps, the swain  
hies homeward to his family, now  
disaster'd stands; sees other hills ascend,

of unknown joyless brow; and other scenes  
of horrid prospect, bleach the trackless plain:

nor finds the river, nor the forest, hid  
beneath the formless wild; but wanders on  
from hill to dale, still more and more astray;

Impatient

impatient flouncing through the drifted heaps,  
 stung with the thoughts of home ; the thoughts of home  
 rush on his nerves, and call their vigour forth  
 in many a vain attempt. How sinks his soul !  
 what black despair, what horror fills his heart ?  
 when for the dusky spot, which fancy feign'd  
 his tufted cottage rising thro' the snow,  
 he meets the roughness of the middle-waste,  
 far from the track, and blest abode of man ;  
 while round him night resistless closes fast,  
 and every tempest, howling o'er his head,  
 renders the savage wilderness more wild.  
 Then throng the busy shapes into his mind,  
 of cover'd pits, unfathomably deep,  
 a dire descent ! beyond the power of frost,  
 of faithless bogs ; of precipices huge,  
 smoothed up with snow ; and, what islands unknown,  
 what water, of the still unfrozen spring,  
 in the loose marsh or solitary lake,  
 where the fresh fountain from the bottom boils.  
 These check his fearful steps ;—and down he sinks  
 beneath the shelter of the shapeless drift,  
 thinking o'er all the bitterness of death,  
 mix'd with the tender anguish nature shoots  
 thro' the wrung bosom of the dying man,  
 his wife, his children, and his friends unseen.—  
 In vain for him th' officious wife prepares  
 the fire fair blazing, and the vestment warm.  
 In vain his little children, peeping out  
 into the mingling storm, demand their fire,  
 with tears of artless innocence. Alas !  
 nor wife, nor children, more shall he behold,  
 nor friends, nor sacred home. On every nerve  
 the deadly winter seizes ; shuts up sense,

and,

and, o'er his inmost vitals creeping cold,  
 lays him along the snows, a stiff'ned corse,  
 stretched out, and bleaching in the northern blast.

THOMSON.

When, through exposure to extreme cold, the fingers, or other external parts of the human body are frozen, the heat in these parts must necessarily be reduced to the lowest point consistent with life. If artificial heat be suddenly applied, a mortification ensues, and the parts that have been *frost-bitten* drop off. But if they be thawed by friction with snow, and afterwards the gentlest warmth be then gradually applied, the parts are soon restored to their wonted use and activity\*.

When the state of torpor or apparent death is brought on, whether in the dormant animals, or man, whether by the sedative effects of cold, or by submersion, the phenomena are extremely similar.

*Both* are bereft of SENSE and MOTION. *Both* lose a large portion of ANIMAL HEAT. *Both* on their first recovery exhibit similar efforts towards restoring RESPIRATION and CIRCULATION. *Both* are restored by a gentle

\* Vide page 422.

*degree* of WARMTH, and are destroyed by a HEAT *too great, or too suddenly applied*. Indeed the GRAND SECRET of the art of restoring *suspended animation*, consists in NICELY ADJUSTING THE NATURAL AND ARTIFICIAL STIMULI TO THE EXACT TONE OF THE IRRITABLE FIBRE.

If the recovery of the *marmot* is more uniformly certain, it is not only because the torpor is more gradual, but because the degree of heat is regulated by the steady, unerring hand of NATURE; whereas in man, it is governed by the uncertain and often capricious rules of ART.

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On the RESTORATION of *suspended animation* much has been already discovered, but much still remains to be explored.

In the prosecution of this laborious undertaking, as in the arduous attempt to ascend the Andes, no sooner have we joyfully gained the overshadowing summit, which bounded our view, than the horizon widens, and discloses still higher eminences, which oppose fresh obstacles to our progress:

“ Hills peep o’er hills—and Alps on Alps arise.”

POPE.

## SECT. XLVI.

OF THE INSTITUTION OF THE HUMANE SOCIETY FOR  
THE RECOVERY OF PERSONS APPARENTLY DEAD.

Since no one from the prince to the peasant can at all times be secure from those dreadful disasters, which suddenly suspend vital action; and since medical practitioners themselves are by no means exempt; it surely becomes them to use every exertion to *improve* the art of RESTORING ANIMATION. May each progressive step in this interesting path of science tend to that great object! And may every laudable attempt, undertaken with that benevolent view, enable us with MORE CERTAINTY TO PRESERVE LIFE, AND TO DIMINISH THE SUM OF HUMAN INFELICITY!

Dr. FOTHERGILL.

WHAT transport must it afford every compassionate bosom, to be instrumental in recalling a helpless fellow-creature from an untimely grave;—to witness, at that critical juncture, the heartfelt passions of anguish and despair, of hope, fear, surprise, and joy, which alternately agitate the human frame;—to mark the lively traits of gratitude painted in the countenances and deportment of the mother, sisters, brothers, &c. of the restored object!—What epicure could ever yet boast so refined, so exquisite a luxury as the benevolent deliverer must experience from such a scene:—a scene far beyond



what any pen as yet hath been able to describe, or pencil to express!

Previous to the origin of this new branch of healing (which indeed constitutes a *remarkable æra* in the science of physic), death apparent and absolute had long been considered as almost synonymous terms. For the subjects of both, appear to have been alike consigned to the silent mansions of the tomb, without its being ever dreamt, that such a vast proportion of the former might, by a few simple means, have been recalled to life, and all the endearments of social happiness.

Of the truth of this important fact, the Transactions of the HUMANE SOCIETY have afforded the most ample demonstration. Little did any man think, not even the founders of this society themselves, inflamed as they were with sacred zeal, that, in the year 1794, there should be recorded 3000 instances, wherein the society's aid had been extended, TWO THIRDS of which had proved successful.

No sooner had the HUMANE SOCIETY surmounted the first difficulties inseparable from a novel undertaking, than it not only fixed the attention of the medical faculty, but also attracted the notice of the poet, the painter, the philosopher, and the divine.

vine. By such collateral aid, but still more by the uncommon exertions of ONE INDIVIDUAL, has this institution at length happily *silenced* all objections, *triumphed* over prejudice, and *diffused* its benefits over a considerable part of the known world \*.

The reader will instantly recollect, that the individual is no other than Dr. HAWES, to whose unremitting zeal and activity, aided by Dr. LETTSOM and a few other such congenial characters, this society owes its existence.

\* Gentlemen, says Dr. LETTSOM (addressing himself to the members of the *Humane Society*, assembled together to see presented their HONORARY MEDAL to Dr. FOTHERGILL for his Prize Essay *on the Suspension of Vital Action*), I cannot resist calling your attention at this moment to the establishment of an *Humane Society* under our auspices at ALGIERS. I repeat ALGIERS; for it is surprising, and almost incredible, though indeed we know it as a fact, that in that barbarous soil a spark of humanity is at length kindled! What a grateful contrast does this present of the Christian system to the barbarity of infidels. In that land, where a MULEY ISHMAEL immolated with his own hand eighty of his relatives, the amities of the Gospel have led to an establishment that saves the life even of a stranger! Those who can recal the commencement and origin of *this institution*, and the state of knowledge at that time, and should next survey the *present accumulation*, must experience singular pleasure in tracing the *progress* and *evolution* of SCIENCE as connected with the subject of the *resuscitative art*, much of which must be ascribed to the *disquisitions* which have resulted from the HONORARY PREMIUMS. I do not speak my *own opinion* merely, but that of *Europe*, for in almost every medical work of character, there are appeals to their judicious authorities as decisive of the facts, which they have established, enforced, and illustrated. Of this kind is the *valuable production*, which has, at this time, brought together so many of our members and friends in the cause of active humanity. Vide page 44, vol. i. also page 4, vol. ii.

HE, undoubtedly, was the first, in this country, who undertook to deliver a course of lectures on SUSPENDED ANIMATION, which was no easy task at that early period. HE also first proposed *honorary premiums* for the further elucidation of the subject. TO HIM, as the ever active agent, may, in a great measure, be applied that emphatic expression of the celebrated LINNÆUS, who on witnessing the superior activity, zeal, and energy, which distinguished LONDON, beyond every other city he had visited, exclaimed with rapture,

*“ Punctum vitæ in vitello orbis !”*

IF SUCH HAS BEEN THE PROGRESS OF THE PRESENT INSTITUTION IN ITS EARLY STAGES, WHAT MAY NOT BE EXPECTED, ADDS DR. FOTHERGILL, NOW THAT PHILOSOPHY HOLDS UP THE TORCH TO MEDICINE, TO ILLUMINE ITS VOTARIES, AND DIRECT THEIR COURSE IN THIS NEW PATH OF SCIENCE! A SCIENCE, NO LESS DIFFICULT, THAN IT IS SUBLIME AND IMPORTANT; INVOLVING AT ONCE, THE MOST INTRICATE PROBLEMS, IN PHYSIOLOGY, PATHOLOGY, CHEMISTRY, AND PNEUMATIC PHILOSOPHY!—CALCULATED NOT LESS TO EXERCISE THE KEENEST FACULTIES OF THE HEAD, THAN TO INTEREST THE FINEST FEELINGS OF THE HEART!

SECT.

## S E C T. XLVII.

JOHN HUNTER'S PROPOSALS FOR THE RECOVERY  
OF DROWNED PERSONS.

Having been requested by a member of the Society established for the recovery of persons apparently drowned, to commit my thoughts on that subject to paper, I readily complied with the request, hoping, that although I have had no opportunities of making actual experiments upon drowned persons, it might be in my power to throw some light on a subject so closely connected with the inquiries which, for many years, have been my favourite business and amusement. I have therefore collected together my observations and experiments relative to the loss and recovery of the actions of life, which I now offer to the public.

HUNTER.

I CONSIDER an animal, apparently drowned, as not DEAD; but that only A SUSPENSION OF THE ACTIONS OF LIFE has taken place. I might compare the situation of such a person to that of a person in a *trance*. In both the action of life is suspended, without the powers of action being destroyed.

Drowning may therefore be defined to be, “ A STOP PUT TO THE ACTIONS OF LIFE IN THE ANIMAL, BUT WITHOUT ANY IRREPARABLE INJURY TO ANY VITAL PART;—WHICH ACTION, IF NOT RESTORED BY ART IN A CERTAIN TIME, IS IRRECOVERABLY LOST.”

The cessation of motion from drowning seems to arise from the loss of *respiration*, and the immediate effects which this has upon the other vital motions of the animal,

except what may have arisen from the agitation of the mind, however the privation of breathing appears to be the first cause; and the heart's motion ceasing, to be the second or consequent; therefore most probably the *restoration of breathing* is all that is necessary to restore the heart's motion; for if a sufficiency of life still exists to produce that effect, we may suppose every part equally ready to move the very instant in which the action of the heart takes place, their actions depending so much upon it.

What makes it very probable, that in recovering persons drowned, the principal effect depends *upon air being thrown into the lungs*, is, what happens in the birth of children, when too much time has been spent after the interruption of that life which is peculiar to the foetus; they then lose altogether the disposition for new life; and in such cases there being a total suspension of the actions of life, the infant remains to all appearance dead, and would in fact die, if *air was not forced into its lungs*, by which means the action of the heart is established.

To put this in a clearer light, I shall give the result of some experiments which I made in the year 1755 upon a dog.

A pair of bellows were provided, constructed in  
such

such a manner, as by one action to throw fresh air into the lungs, and by another to suck out again the air that had been thrown by the former, without mixing them together.

The muzzle of these bellows was fixed into the wind-pipe of a dog, and by working them he was kept perfectly alive.

While this *artificial breathing* was going on, I took off the sternum of the dog, and exposed to view the heart and lungs. The heart continued to act as before, only the frequency of its action was considerably increased.

I then stopped the motion of the bellows, and the heart became gradually weaker and less frequent in its contraction, till it left off moving altogether.

By renewing my operation, the heart begun again to act, at first very faintly, and with longer intermission; but by continuing the *artificial breathing* its action became as frequent and as strong as ever.

I observed that every time I left off working the bellows, the heart became extremely turgid with blood, and the blood in the *left side* became as DARK as that on the *right side*; both sides of the heart having the SAME COLOURED BLOOD\*, which was not the case when the bellows were working.

\* Please to compare the Plate on the *opposite page* with the *Map of the Heart* in Vol. I.



THIS SITUATION OF THE ANIMAL APPEARS TO ME EXACTLY SIMILAR TO DROWNING †.

Before I offer my sentiments on the method of treating persons who are apparently drowned, it may be necessary to state *three* propositions.

- 1st. So long as the animal retains the *power*, though deprived of the *action of life*; the cause of that privation being removed, the animal recovers.
- 2d. It is necessary to mention, that I consider the *living principle* as inherent in the BLOOD, viz. *that principle* which prevents the corruption of the body, and is the cause of all its actions.
- 3d. The last proposition I have to establish is, that the *stomach* sympathizes with every part of an animal, and that every part sympathizes with the stomach; therefore whatever acts upon the stomach, as a cordial, or rouses its natural and healthy actions, and on the contrary whatever affects it, so as to produce debility, has an immediate effect upon every part of the body.

\* This experiment of JOHN HUNTER resembles that made by Dr. GOODWIN, p. 79; to which, with great satisfaction, we refer the reader on the present occasion.

## PROP. I.

When assistance is called in, soon after the immersion, AIR blown into the lungs may be *sufficient* to effect a recovery. The DEPHLOGISTICATED AIR \*, described by Dr. PRIESTLEY, may prove more efficacious than *common air*. It is easily procured, and may be preserved for any length of time in bottles.—HUNTER.

[To restore a person from a temporary suspension of vital action, is within the province of the physician: but to restore life, after it has entirely vanished, is an

\* As the doctrine of *phlogiston* is nearly exploded, *this gas* will be better understood by the term OXYGEN, or VITAL, AIR. These proposals were first published in the PHILOSOPHICAL TRANSACTIONS, and afterwards in his work on the ANIMAL ŒCONOMY; but, as JOHN HUNTER often lamented, he made *no converts!* “Whatever philosopher,” says this great anatomist, “shall hereafter investigate the operation of *air* in the animal œconomy, and will pursue my ideas of the vitality of the blood, he will become a benefactor to mankind, and his name will be immortal!” Vide PART II. VOL. I. page 354.

act of Omnipotence, and belongs only to HIM, who gave it. The former is merely to rekindle the flame of a taper, by gently fanning the ignited wick : the latter, to reanimate a corpse, after the vital spark is totally extinct.

From the effects of VITAL AIR,

1st. In giving a *florid colour* to the blood,

2d. In generating *animal heat*.

We learn, why in suspended respiration, the lungs ceasing to expand, and the blood to be changed in that organ, the heart ceases to contract, the arteries to vibrate, and finally, why the machine, though sound and entire in all its parts, yet on a sudden, like a clock whose *pendulum* is stopped, remains entirely at rest. In the latter, if we move but the pendulum, the wheels are immediately put into motion, and the clock again correctly marks its hours and minutes as before : so likewise in the animal machine (for such is the harmonious consent of parts), that if motion can but be renewed in one of the principal organs, it is directly communicated to the next, and from thence to all the rest.

Thus if the lungs expand, and the blood imbibes the VITAL AIR, the heart recovers its action, the brain

its energy, the nerves their sensibility : the grand obstacle once removed, the subordinate springs of life presently resume their respective movements.

From the privation of VITAL AIR in drowning, we can now explain, why the blood grows dark, the lips and countenance livid, and why the body loses its native heat ; since, by renewing respiration, circulation is renewed, and the blood, having regained its florid colour, all these symptoms soon disappear.

The primary object, therefore, in the suspension of vital action, is to institute ARTIFICIAL RESPIRATION till the NATURAL BREATHING can be re-established.

Those, who attribute the efficacy of this process to the mere mechanical expansion of the lungs, for the easier transition of the blood, regard not the quality of the air ; nay some even have the folly to contend, that air blown warm from the lungs of a healthy person is better than atmospheric air.

Others deny that air, already vitiated by respiration, can be fit for the purpose (to say nothing of the indelicacy of the operation), and therefore justly prefer atmospheric air.

Being among the first, continues the illustrious Dr. FOTHERGILL, who recommended VITAL AIR in preference to the other two, not only from theory, but *actual experiment* on some of the smaller animals, its superiority has since been confirmed by many respectable writers both at home and abroad.

Nor is this to be wondered at, seeing it possesses every necessary quality of common air, in a super-eminent degree, and is alone capable of producing that chemical change in the blood, upon which *vital heat* and *irritability* depend. For during the suspension of respiration, agreeable to what has been before hinted, the blood loses its florid colour, from being deprived of the VITAL PART of the atmosphere. The animal heat is diminished, and the action of the heart grows suddenly weaker every moment, until at length it ceases altogether.

In the act of drowning it is also well known, that though suffocation generally takes place after a full expiration, that from 50 to 100 cubic inches of air still remain in the vesicles of the lungs. This stagnant air must therefore be highly vitiated, and therefore injurious to life, it cannot be evacuated by pressure, much less  
 meliorated

meliorated by similar air conveyed from another person's lungs; it may however be corrected by atmospheric air, and completely restored by VITAL AIR.

On the whole, it seems reasonable to conclude, that in the treatment of drowned persons, respired air must be less proper than atmospheric, atmospheric than VITAL; and could the latter be as easily and cheaply procured as the two former, few persons could hesitate a moment in determining which of them they ought to prefer.

Whence is it then, that the use of VITAL AIR has hitherto been withheld from the human species, and confined to a few experiments on brute animals? Because it is even yet but little known; and its virtues less understood.—A remedy rarely to be had when most wanted, and never without some trouble and expence. But we may soon, however, expect some decisive experiments on this head, now that the VITAL AIR has not only unfolded the theory of respiration, digestion, and the animal heat, but also explains many other curious phænomena both in health and disease, and has been prosecuted with such uncommon ardour, as to give birth to some of the most brilliant discoveries that shed lustre



on the present æra.—*From Dr. FOTHERGILL's Prize Essay on the Suspension of Vital Action.*]

## PROP. II.

It frequently happens in the case of drowning, that assistance cannot be procured till a considerable time after the accident; every moment of which delay renders recovery more precarious, the chances of which are not only diminished in the parts where the first powers of action principally reside, but also in every other part of the body.

If a considerable time, such as an hour, has been lost, it will seldom be sufficient to inflate the lungs with air; the heart having by this time lost its nice connection with the lungs.

It will be necessary, having first inflated the lungs, to apply *volatile salts* to the nose. It will be better if it be applied up both nostrils, as such applications to the *olfactory nerves* are known to rouse the living principle and put the muscles of respiration into action, and are therefore likely to excite the action of the heart. Besides  
the

the salt of *vinegar*, the steam of the same may be employed, for affections of those nerves greatly affect the living principle, for while a strong smell of very sweet flowers, as orange-flower, shall in many cause fainting, the application of *vinegar* will immediately restore the powers to action again. Thus all perfumes in which there is some *acid*, rouses rather than depresses, as the sweet-brier, essence of lemon, &c.—HUNTER.

### PROP. III.

*Electricity* has been known to be of service, and it is probably the only method we have of immediately stimulating the heart; all other methods being more by sympathy.—HUNTER.

[The effects of electricity were, some time ago, finely illustrated by the ingenious ABILGARD, in many curious experiments on apparently dead animals; wherein, by a dexterous management of its power, he is said to have been capable of alternately suspending and restoring  
animation

animation at pleasure. The experiments have since been repeated by an eminent electrician \* in London, and with similar effects. On smart shocks being passed through the head, the animal immediately becomes motionless: on transmitting the gentlest vibratory shocks through the region of the heart, oscillations of the external muscles instantly ensued.

When the operation was suspended for some minutes, or its duration altered to more remote parts, the animal relapsed into its quiescent state, and constantly revived on its being repeated as at first. And what is very worthy of attention is, the vital organs were more certainly excited, and more vivid motions produced by slight, than when the shocks were increased; the latter appearing to retard, rather than promote recovery. It was also found, by the last experienced electrician, to afford present relief in syncope, though when administered with violence in people of a nervous habit, it is known frequently to produce that state.

From the above phænomena it seems reasonable to conclude, that electricity ought to be principally directed to the heart, lungs, and diaphragm, in the form of

\* PARTINGTON.

gentle shocks. Applied in a moderate degree, it excites vital action after other stimuli have ceased to act: carried to an extreme, it destroys irritability, and life itself. For whether the stroke be sent from a thunder-cloud, or a highly charged electrical battery, is immaterial; the effect from either may alike prove fatal. Electricity, therefore, presents us with one of the most powerful stimulants hitherto discovered, which, like other active remedies, may be *salutary* or *injurious*, according as it is managed. Hence the impropriety of those violent shocks of electricity formerly given in palsy, chlorosis, &c. which, like other exhausting stimuli, not only defeat the intention, but prove extremely injurious. Hence, perhaps, the surprising success of electricity in some cases that appeared desperate; and its failure in others, after it had produced some flattering tokens of recovery. Instances of both which are to be met with in the Reports of the *Humane Society* for the years 1787 and 1789. Nor is this to be wondered at, seeing its effects may be so greatly diversified according to the different modes of application, by which its powers are adjusted. Thus it may be directed to pass silently along the metallic wire; to melt it instantly; or disperse it with incredible fury. Thus a violent blast of air ex-

tinguishes the burning taper, while a gentle breeze rekindles it. In like manner, the tickling the soles of an infant causes convulsive laughter; while rubbing that part produces no such effect.

As it is known from various observations, that the blood passes most freely through the pulmonary vessels, when the lungs are expanded by a full inspiration; if at this juncture, the heart can be excited to exert its power, while the resistance is so considerably diminished; it must more easily propel the blood forward, when part of it will enter the left cavity, now almost empty. This being brought into action, will, in its turn, urge it forward into the arterial system.

As soon as the lungs, therefore, are fully expanded with air, and the more *pure* this is, undoubtedly the better; at that moment, let the heart be excited by a gentle electrical shock, passed obliquely from the right side of the chest through the left, in the direct course of the heart, and pulmonary vessels. Let the lungs be now emptied of the air, and again expanded, when another shock may be given. The heart being thus excited into action, the *black blood*, loitering near its right cavity, will begin to move forward, and to resume a more *florid colour*. This being gradually renovated,  
will

will renew the action of the left auricle, where the circulation will also be speedily restored, and that, perhaps, with more certainty and expedition, than by the usual mode of conducting the operation.—Dr. FOTHERGILL.]

#### PROP. IV.

It will be necessary to convey some stimulating substance into the *stomach*, to rouse this seat of universal sympathy. This operation should be performed with all possible expedition, because the instrument, by continuing in the mouth, might produce sickness, which would tend rather to distress than rouse the living principle.

The process recommended under the first head of treatment should still be continued, while those under the other heads are putting into practice; for I consider these only as auxiliary to the first. The first, in many cases, may succeed alone; but the other injunctions without the first must, I think, always fail where the powers of life are considerably weakened.—HUNTER.

[When the heart has once been made to receive the



florid blood, it will be stimulated to new action, and the vital functions will be restored. It will not, however, be sufficient to stimulate the *heart* and *lungs*, we must at the same time stimulate the *stomach*. Clearly to comprehend the purpose of this operation, the reader should be previously well acquainted with the discoveries of modern chemists. I have said wine must be conveyed into the stomach; but he should not be satisfied with being guided by the hand, without understanding the reason why such an application is attended with success. In the use of medicines he should endeavour to ascertain their mode of operation; for while the rash empiric wanders in the dark, the cautious and rational practitioner will be anxious to investigate the path of nature, and to account for her proceedings, while he ventures to prescribe. I shall attempt therefore to throw some light upon a subject which is *new*, and therefore little understood.

It is well known from chemistry that, in nature's laboratory, the juice of the grape is composed of three ingredients,

- $$\left\{ \begin{array}{l} 1. \text{HYDROGEN,} \\ 2. \text{OXYGEN,} \\ 3. \text{CARBON.} \end{array} \right.$$

By .

By the process of distillation, the HYDROGEN is separated in a great measure from the OXYGEN and CARBON, and we obtain what is called *alkohol* or *brandy*.

*Alkohol* itself contains some oxygen, but by combustion, it takes to itself still more from the atmospheric air: and thus by experience it is found, that 16 ounces of *alkohol*, by combustion produces 18 ounces of pure *water*.

The combustion here is nothing else but the combination or chemical union of HYDROGEN with OXYGEN, from which results a third substance *water*, whilst the HEAT which was before in combination with oxygen escapes.

PILATRE DE ROZIER has frequently amused his friends by inhaling a large quantity of HYDROGEN AIR; which may be taken into the lungs without fear of injury, and then, applying his mouth to a tube, he blew out the air unmixed with atmospheric air, and fired it at the end of a tube, so that he appeared to breathe *flame*. By this operation water was produced, which ascended in the form of vapour.

In order to give a distinct idea of the quantity of heat arising from the combustion of HYDROGEN AIR, I shall only mention that one pound of this melted 295 lb. of

ice, whereas in similar circumstances wax candles \* weighing one pound melted only 133 lb.

These observations I have presented to the student, in order to give him a clear and distinct idea of the substances which I have had occasion to mention; and by which he will see the strong affinity and chemical attraction between HYDROGEN and OXYGEN, the latter of which, as I have stated, is by the *lungs* derived from the atmosphere, whilst the former is conveyed into the system by the assistance of the *stomach*, and is most readily obtained from æther, alcohol, and wine.

So much for what has been discovered by the chemist with his retorts. But it is time that we should return to the living retort, and consider by what laws the proportions are established between the OXYGEN to be derived by inspiration from the atmosphere, and the HYDROGEN to be conveyed into the system by the action of the stomach.

The reader, no doubt, calls to mind the memorable experiments of Mr. SPALDING, who observed that in proportion to the quantity of food received into the stomach, if it abounded with HYDROGEN, the system

\* These form fixed air (*carbon and oxygen*).

coveted OXYGEN, taking up a greater quantity of it by respiration from the atmosphere, as his diving-bell clearly demonstrated, and he will also remember having met with this remark in the case of bilious autumnal fever,  
*“ The attentive observer will take notice, that there is a  
 “ certain proportion between the VITAL AIR received  
 “ into the lungs, and THE QUANTITY OF FOOD  
 “ which can be digested in the stomach \*.”*

When I made the last observation I was not aware that the same had occurred to any one before me. But I have the pleasure to see the same idea had also occurred to Dr. THORNTON, as appears in his *Thesis*, and to Dr. BEDDOES, as is seen in his *Letter* to Dr. DARWIN. He had been breathing air, such as contained almost equal parts of OXYGEN and AZOTIC AIR. *“ His spirits were in  
 “ consequence elated; his appetite great; and he eat one  
 “ third or one fourth more than before, without feeling his  
 “ stomach loaded †.”*

From these premises I trust it will be clear, why, in cases of suspended animation, we must not be contented merely with conveying VITAL AIR into the *lungs*, but

\* Vide PART II. VOL. I. page 89.

† Vide PART III. VOL. II. page 256, where this memorable experiment is related at length.

must

must at the same time convey HYDROGEN into the *stomach*, which powerfully attracts this substance so essential to vitality.—From the Rev. Mr. TOWNSEND'S *Guide to Health*.]

[In time of health, cordials, on being received into the stomach, presently manifest their enlivening effects : even before they can have time to enter the lacteals, their stimulus is diffused through the remotest parts of the system. In order, therefore, to restore the motion of the heart, through the medium of the stomach, some active cordial ought to be early administered. This having been considered by the faculty as unsafe, if not wholly impracticable, until the power of swallowing should be restored, it has hitherto on that account been very rarely attempted. Fortunately, however, we can now with confidence assert, that instead of waiting for the return of deglutition, an event which may never happen, fluids may at the beginning be immediately conveyed into the stomach, without occasioning the smallest hazard of suffocation.

Amongst the class of internal stimulants, spirituous liquors, as rum, brandy, or usquebaugh, are well adapted, as being speedy in their operation : but  
the

the exhausting effect which succeeds the action of these, and all other potent stimuli, tends to limit their use, and demands no small circumspection.

Good wine, where it can be had, though less active, affords a more generous cordial, and seems to deserve the preference ; for during vital suspension, *irritability* must be considerably *accumulated*. Hence the necessity of artificial stimuli to compensate for the defect of the natural ones in carrying off the *redundancy*. But if these are too powerful they may prove equally destructive, by totally exhausting the moving fibres. Thus may the salutary efforts of nature be overpowered by the officiousness of art, a circumstance which sometimes we have had occasion to observe with regret.—Dr. FOTHERGILL.]

## PROP. V.

While these things are going on, viz. the INFLATION of the *lungs* and STIMULATION of the *heart*, an assistant should carefully *heat* the bed-clothes. I consider *heat* as congenial to the living principle. But from observations and experiments it appears to be A LAW OF NATURE in animal bodies, that the *degree* of *external heat* should bear *proportion* to the *quantity* of *life*; as it



is weakened, this proportion requires 'great accuracy in the adjustment; while greater powers of life allow a greater latitude.

I was led to make these observations by attending to persons who are *frost-bitten*; the effect of cold in this case being that of lessening the living principle. The powers of action remain as perfect as ever, only weakened; and heat is the only thing wanting to put these powers into action; yet heat must at first be *gradually* applied, and proportioned to the quantity of the living principle; but as that increases you may increase the degree of heat.

If this method is not observed, and too great a degree of heat is at first applied, the person or part loses entirely the living principle, and mortification ensues. This process invariably takes place with regard to men. The same thing, I am convinced, happens to other animals. If an eel, for instance, is exposed to a degree of cold sufficiently intense to benumb it till the remains of life are scarcely perceptible, and still retained in cold of about 40 degrees; this small proportion of living principle will continue for a considerable time without diminution or increase; but if the animal is afterwards  
placed

placed in a heat of 60 degrees, after shewing *strong signs* of returning life, it will die in a few minutes.

If a lizard, or snake, be taken from its autumnal hiding place, and exposed to the sun's rays, or placed in any situation which would give vigour to the same kind, possessed of a larger share of life, they will immediately shew signs of *increased*\* life, but quickly sink under the experiment and die; while others, reduced to the same degree of weakness, as far as appearances can discover, will live for many weeks, if kept in a degree of cold proportioned to the quantity of life they possess.

I observed many years ago, in some of the colder parts of this island, that when intense cold had forced black-birds or thrushes to take shelter in out-houses, any of them that had been caught, and from an ill-judged compassion exposed to a considerable degree of warmth, died very soon. The reason of this I did not *then* understand; but I am *now* satisfied, that it was owing, as in other instances, to the degree of heat being increased

\* *Sedative powers*, says Dr. BROWN, weaken the tone of the fibre, but by accumulating IRRITABILITY, they predispose the fibre to an *inordinate action* upon the application of a *slight stimulus*. How much does Dr. BROWN's and JOHN HUNTER's doctrine then *coincide*, if we except the *difference of expression*!

too suddenly for the proportion of life remaining in the animal.

From these facts it appears, that warmth calls forth a great exertion of the living powers; and that an animal in a weakly state may be obliged to exert a quantity of the actions of life sufficient to destroy the very powers themselves. Heat must therefore be carefully regulated according to the return of the powers of life, and must be adjusted accordingly.—HUNTER.

[*Heat* is so essential to life, that without a certain degree of it, neither animals nor vegetables could subsist. The eggs of oviparous animals, the seeds of vegetables, and growing plants, discover, by the thermometer applied to their internal parts, a degree of temperature evidently exceeding that of the circumambient atmosphere. Heat accompanies the embryo from the earliest period to the last stage of its existence, and therefore has been considered by some as the source of vitality. Hence, the fecundating egg brings forth in due season, whether the proper degree of heat be communicated by incubation, or by the temperature of a well-regulated oven. Hence, also, the myriads of animated beings, which,  
from

from imperceptible ova, are ushered into existence by the summer's sun! Hence dormant animals are roused from a torpid state, by the vernal warmth; and hence too, drowned persons have sometimes been reanimated by the solar rays

From these, and similar considerations, it was very natural to conclude, that to restore heat to the body, must be one of the most powerful means of restoring animation. Accordingly, it has hitherto been attempted, by the application of artificial heat; under an idea, that until this could be accomplished, every other means would prove ineffectual: without considering, perhaps, that an inanimate substance of such a bulk as the human body, containing a large quantity of matter under a small surface must acquire heat very slowly: that to accomplish this in the internal parts (were it even practicable with safety) would demand great length of time, during which other measures no less essential must be postponed.

When *respiration* ceases in a drowned animal, the power of *generating heat* is suspended, and the body loses the remains of its natural warmth, till at length it is reduced to the temperature of the surrounding medium. During this, if we attempt to raise the heat suddenly to  
the

the natural standard, we exhaust the feeble remains of life. Nay, although we apply artificial heat by flow degrees, yet still, if no other means are used, it fails of success. But if we have first recourse to *artificial respiration* in the manner already described, the experiment will often succeed and produce the desired effect. The lungs being thus supplied with air, the blood is again rendered fit to receive a fresh supply of latent heat, and to diffuse it, through innumerable arteries and veins, from the centre to the circumference. Thus is the natural heat restored, and communicated to every part of the system, with more certainty and expedition, than by any external means that can be devised.

The most efficacious method of restoring heat then, is to renew the *generating power*, by renewing *respiration*. For, till this natural process can be re-established, all that can be reasonably expected from the application of artificial heat, is to prevent the natural heat from being conveyed off; and to preserve sensibility and irritability, till the generating power can be renewed, on which they so intimately depend. Even in this view, it is a matter of considerable importance, and demands no small attention in the management.

Where the temperature of the body is considerably

reduced, a small degree of additional heat will produce powerful effects. Hence with dormant animals that are torpid, a moderate degree of additional heat revives them; whereas a greater, even such as imparts vigour to them under other circumstances, speedily destroys them.

Thus nature instructs us that the artificial heat employed in restoring animation, ought to be very moderate; and the more so, in proportion as the natural heat is diminished.

If, at the lowest pitch of temperature, the application of snow, or cold water, affords a more safe and efficacious stimulus than artificial heat, is there not some reason to suspect, the cooling method might also prove preferable, at all the intermediate degrees?—That in drowning, for instance, where the temperature of the body, through exposures to extreme cold, is often reduced many degrees below the standard, might not a momentary application of this method, at the beginning of the process, prove more salutary, than that sudden transition to artificial heat adopted by modern practitioners?

The heat might be augmented by degrees, and the person put between blankets, and bladders of tepid water,

or



or flannels wrung out of the same, or in vinegar, might in some measure supply its place. These may be applied to the region of the stomach; to the arm-pits; to the groin; and to the extremities: their warmth being retained by a covering of warm flannel. The room should have no visitants to corrupt the air, its heat should be between 56 to 64 degrees of Fahrenheit's scale. But let it be ever remembered, that till the *generating power* can be restored to the frame, it is in vain that we attempt by these, or any other means, to raise the heat of the body to the natural standard.—Dr. FOTHERGILL.]

## PROP. VI.

*Motion* may possibly be of service, it may at least be tried; but, as it has less effect than any other of the above prescribed stimuli, it should be the last part of the process.

I would recommend to the operator the same care in regulating the *proportion* of every one of these methods, as I did before in the application of *heat*; as every one of them may possibly have the same property of entirely  
destroying

destroying the feeble action which they have excited, if administered in too great a quantity; instead therefore of increasing and hastening the operations on the first signs of returning life being observed, as is usually done, I would recommend their decrease, or that they be adjusted as nearly as possible to the powers as they arise. As the heart is commonly the *last part* that ceases to act (*ultimum moriens*), it is probably the *first part* that takes on the action of recovery. When it begins to move, I would advise the observing, with great attention, when the muscles of respiration begin to act, that our endeavours may not interfere with their natural exertions, and that we may co-operate with nature; and I would advise the lessening also, at this time, by degrees, the application of air to the lungs.—HUNTER.

[Brisk *agitation* is best performed between two people; one taking hold of the patient's feet, while the other supports the shoulders, with the head properly elevated. This has of late been suspected of having a dangerous tendency, though apparently without any just cause. It certainly affords a safe and speedy mechanical stimulus to the whole machine, and may be executed in

less than three minutes ; producing all the advantages that could be hoped for from the action of an emetic, and without the danger.

The successive concussions thus communicates to the part and internal organs, tend to put the stagnant blood in motion ; to renew oscillations in the moving fibres ; and to incite the hidden springs of life into action.

By brisk agitation still-born children have sometimes also been unexpectedly brought to life. Sometimes drowned persons have been restored by the same means.

Being a simple and harmless effort to restore animation, and easily performed by the lower class of people, it ought by no means to be discouraged. If it fails, it does no injury, unless it be performed with unnatural violence : if it succeeds, it supersedes the use of other measures.

A remarkable instance of recovery accidentally occurred some years ago, where a sudden jolt of a coffin is said to have disturbed the repose of the apparently dead lady within ; who, to the surprise of the persons shoving the coffin, and utter confusion of her husband, instantly gave a piercing shriek ! This, being repeated in her usual shrill and well-known key, left him no room to

doubt of his *cara sposa* being actually alive. It therefore obliged him, though very reluctantly, to counter-order the sepulchral ceremonies, and release the supposed corpse; who, it is added, lived many years after, till at last she had the satisfaction of seeing her husband “peaceably inurned” in the very same spot intended for herself.—Dr. FOTHERGILL.]

## PROP. VII.

The steam of some *stimulating substances*, which are of a warm nature, should be employed as an enema.—HUNTER.

[Not only the *stomach*, but the *intestinal tube* annexed, constituting the alimentary canal, is every where most bountifully supplied with nerves, by which an intercourse is carried on with all the principal organs, and propagated to the remotest parts, of the system. This canal, therefore, through its whole extent, may be well considered as the centre of sensibility and nervous sympathy; and consequently deserves particular attention in all cases of vital suspension. Hence various

stimulants have been proposed for supporting its peristaltic motion, and for rendering it a proper medium for renewing nervous energy, by means of its sympathy with the other vital organs.

Forms of enema. 1. Take half a pint of Madeira wine, add one drachm of the tincture of cinnamon or lavender, or half a drachm of pure spirit of sal ammoniac.

Or 2. Take, of warm water half a pint, of fresh mustard half an ounce, of etherial oil of turpentine two drachms. The whole to be incorporated with the yolk of an egg.

Or 3. Take of strong infusion of horse-radish root twelve ounces, of pure sal ammoniac one drachm.—Dr, FOTHERGILL.]

## PROP. VIII.

*Friction*, with agitation of the body, were the earliest methods employed for the recovery of the drowned; and still constitutes almost the only means known to the common people. Notwithstanding the rude unscientific manner in which they generally conduct the former

former operation, yet there are not wanting instances of its success, which probably would have been more numerous, had it been directed by more skilful hands.

Its general effects may be understood, from its stimulating the extremities of the cutaneous nerves, which sympathise with the principal internal organs. But still more, in the present instance, from its exciting the arteries to propel the blood into the corresponding veins, and from thence forward to the heart, while it favours the production of animal heat.

In order to render friction perfectly safe, and at the same time to give it its full efficacy, the following cautions may not be unnecessary.

1. Violent friction, in these cases, is generally unnecessary; it seldom can be useful; and it may often prove hurtful.
2. To obviate any danger that may arise from friction, artificial respiration, with electricity, ought in propriety to precede its use, that a free passage may be first opened through the lungs, when friction may be safely pursued with more freedom.

3. Where



3. Where, through want of skilful assistants, the previous process cannot be properly managed, the friction ought to be more gentle; beginning at the upper and lower extremities, where the circulation is always the most lingering, proceeding gradually to the thighs, abdomen, and chest; where it should be occasionally suspended, about half a minute at intervals, for the heart to evacuate itself.
4. Upon the whole, friction may be performed to the best advantage by the hands alone; the natural warmth of which will be communicated to the body, and gradually increased by the continued attrition.
5. Next to friction with the warm hand, the rubbing with a flesh-brush may occasionally be had recourse to: or, what may prove still more advantageous, hare skins, or warm flannels, which may be well impregnated with the penetrating fumes of gum benzoin, kept in readiness in a state of fusion: besides its stimulating and gently bracing quality, which seem well adapted to the present purpose, this fragrant gum possesses a pleasant

fant odour, which, instead of annoying, may prove grateful to the medical assistants, during their benevolent and truly meritorious exertions in the cause of humanity.—Dr. FOTHERGILL.]

### PROP. IX.

I would by all means discourage *blood-letting*; which I think weakens the animal principle, and life itself, consequently lessens both the power and disposition to action: and I would advise to be careful not to call forth any disposition that might depress, by introducing any thing into the stomach, which ordinarily creates *nausea*, as that also will have a similar effect. I would therefore avoid throwing up any enema, which is likely to produce an evacuation, as every such evacuations also tend to lessen the animal powers. I have purposely avoided speaking of the *fume of tobacco*, which always produce sickness or purging, according as they are applied.—HUNTER.

Whoever is appointed for the purposes of recovering drowned persons, should have an assistant, well acquainted

quainted with the methods intended to be made use of ; that while *one* is going on with the first and most simple methods, the *other* may be preparing what else may be necessary, so that no time may be lost between the operations ; and *the more so*, as the *first means* recommended will, in all cases, assist the *second*, and *both together* may often be attended with *success*, though *each separately* might have *failed*.

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In concluding these proposals for the recovery of drowned persons, we would exhort the humane practitioner, and all others, to trust in God's mercy, and not to despair until every exertion has been duly employed.

LATEAT SCINTILLULA FORSAN,  
should be constantly remembered upon every such melancholy occasion.

## SECT. XLVIII.

A SUMMARY OF THE WHOLE DOCTRINE RELATIVE  
TO THE RECOVERY OF DROWNED PERSONS.

Does not the union of judgments, viz. of JOHN HUNTER, Dr GOODWIN, the Rev. Mr. TOWNSEND, Dr. FOTHERGILL, and Dr. CURRIE, indicate that we have reached to *some certainty* in these important and curious investigations?

HAVING thus impartially examined at some length the remedies employed for the restoration of suspended animation, and endeavoured to ascertain their merit with a view towards improvement; we proceed to reduce the method of conducting the process into a more compendious form.

In all cases of apparent death, time presses, and the urgency of the case demands uncommon expedition. In this critical situation, the *vital spark*, like the last glimmering of a taper, at each succeeding minute, grows more and more feeble, till the instant it expires! Every moment is precious to one who hangs, as it were, betwixt time and eternity.

To prevent delay, by which, alas! too many have already perished, proper HOUSES OF RECEPTION, supplied

with the necessary APPARATUS, ought to be established at the expence of the parish, in every *market town* situated near lakes or rivers, and particularly in all *seaports* throughout the kingdom.

The overseers of the poor, church-wardens, and clerks of the several parishes, should be *instructed* in the means proper for the recovery of drowned persons: for the operation of inflating the lungs completely, demands considerable address; and as it constitutes the most important part of the process, it were to be wished, that not only medical pupils of all denominations, but also other intelligent persons, in every parish, were fully instructed how to perform it with dexterity.

Possessing the proper instruments\*, the most efficacious measures should be immediately pursued by the assistants; not in hurry and confusion, but with method and regularity, conformable to a well digested plan.

As soon as the object arrives, all spectators should be excluded the room, except those that are absolutely ne-

\* These may be seen at Savigny's, No. 28, King-street, Covent Garden, &c. They owe their improved state chiefly to Mr. COLMAN and Dr. CURRIE, who have each obtained prizes for their able works on *suspended animation*. The former approximates to the doctrine exhibited in these pages; the latter exactly coincides with our opinion.

cessary,

cessary, and which perhaps never need to exceed seven in all, including the medical assistants.

A greater number will not only embarrass the operation, but render the air impure by their respiration, and the contaminated air of a crowded room, in cases apparently favourable, may defeat all hopes of success, as we have seen with regret in more than one instance.

If the weather will permit, the windows should be kept open, and temperature be regulated between 56 and 64 of Fahrenheit's thermometer.

If the season be perfectly serene, the body may be placed in the open air to receive the genial warmth of the solar rays, while the other necessary means of recovery are pursued.

The body, if wet, must be immediately well dried, to prevent the chilling effects of evaporation, and then be wrapped in warm blankets, or the warm clothes taken from some of the spectators, unless the cooling process should be first necessary, in consequence of the object being in a half frozen state. For in that case, it ought to be rubbed with snow, or flannels wrung out of cold water or vinegar, before any degree of artificial warmth can be safely applied.



Having prepared a bed or mattress, on a table of a proper height, the body is to be placed thereon, with the head elevated by two pillows; when the different parts of the process may be conducted in the following order.

1<sup>st</sup>. Let the lungs be immediately inflated by means of the proper instruments. When no medical assistant can be had in time, this operation may be tolerably performed, even by the common people, by only inserting the pipe of a pair of bellows into one nostril, while the mouth and opposite nostril are closed by an assistant, and the wind-pipe gently pressed back. Then by forcing air into the lungs, and alternately expelling it by pressing the chest, respiration may be imitated. Or, upon an emergency, air may be blown into the lungs through a tobacco-pipe, a quill, or even a card folded into the form of a tube.

Not only this, but the rest of the process might certainly be performed without much difficulty by the common people, were they properly instructed; since it appears that, in HOLLAND, more than half the recoveries of the drowned are brought  
about

about by them alone, though, at home, we know but few instances of this sort.

2<sup>ly</sup>. The electrical machine being prepared, and the lungs expanded, let one discharging rod be placed just below the right breast, and the other above the short ribs of the left, the electrometer being moved a quarter of an inch from the jar, let the electrical current be passed directly through the heart. The electrical shock being given, let the lungs be emptied by making an expiration with the double bellows, or by suffering air to escape by the mouth, while gentle pressure is made on the chest. The moment this is accomplished, let the lungs again be expanded, and the shock repeated, varying its direction, its power, and its frequency, as circumstances may point out.

3<sup>ly</sup>. Particular stimuli may next be applied to the organs of sense, as a strong light to the eye, and pungent substances to the olfactory nerves, especially the salt of vinegar.

4<sup>ly</sup>. These operations being carried on for five minutes, let the stimulating cordial be conveyed through the flexible tube into the stomach, by

pressing the vegetable bottle in which it is contained.

5<sup>ly</sup>. Immediately after this, either of the stimulating enemas \*, may be also properly administered, or what would perhaps be preferable, warm VITAL AIR. The cordial, and enema, may, if necessary, be repeated near the close of the process.

6<sup>ly</sup>. These internal stimulants being given to provoke the action of the heart, bladders of tepid water should be applied to the region of the stomach, and to the extremities.

7<sup>ly</sup>. The legs and arms must be now diligently rubbed with the warm hand, or with flannel, or a hare-skin, impregnated with the fumes of gum benzoin. The friction must be gradually extended to the thighs, abdomen, and chest.

8<sup>ly</sup>. At that critical period, when sneezing, flight twitchings, or gasping, mark the first dawn of returning life, instead of increasing, it will be prudent to moderate the stimulating powers.

\* Vide page 592.

9<sup>ly</sup>. The process above mentioned should be continued the full space of three hours, with very few intermissions, unless the vital functions should be restored sooner. If, at the end of that period, the unfavourable symptoms, instead of diminishing, should increase, the case may be considered as utterly hopeless, and therefore the process may be discontinued. Still, however, before quitting the room, it may not be improper to order a strong blister to be applied to the region of the heart, and warm sinapisms to the feet, first sprinkled with the volatile alkaline spirit.

10<sup>ly</sup>. When the natural respiration, and the power of swallowing are restored, the patient should be put into a bed moderately warm, with his head properly raised, and his feet wrapped in warm flannel. Warm whey, and other diluents, may now be administered, to encourage a gentle perspiration. But he ought by no means to be left alone, till he has perfectly recovered his senses: some persons having relapsed, and afterwards perished, from being deserted too soon, even after the functions were apparently restored. Unhappy instances

instances of this sort have been properly noted in the Society's Reports.

- 11<sup>ly</sup>. Should feverish symptoms ensue, accompanied with a sense of heaviness, or dull pain in the head or chest (as frequently happens in consequence of the severe discipline so lately undergone), moderate bleeding, together with mild laxatives and cool regimen, will generally afford the desired relief.

## S E C T. XLIX.

## OF ASPHYXIA FROM UNRESPIRABLE AIRS.

When an animal is immersed in water, his pulse becomes weak and frequent; he feels an anxiety about his breast, and struggles to relieve it; in these struggles, he rises towards the surface of the water, and throws out a quantity of air from the lungs. After this, his anxiety increases, his pulse becomes weaker; the struggles are renewed with more violence; he rises towards the surface again; throws out more air from his lungs, and makes several efforts to inspire; and in some of these efforts, a quantity of water commonly passes into his mouth; his *skin* then becomes *blue*, particularly about the *face* and *lips*; his *pulse* gradually *ceases*; the *sphincters* are *relaxed*, and he falls down *without sensation*, and *without motion*.

This description of *drowning* applies, as far as the circumstances admit of comparison, to the *effects* occasioned by *unrespirable airs*. I have had occasion, says Dr. BEDDOES, to remark them in a number of persons, who were curious to try how long they could breathe HY-



DROGEN GAS. The *frequency* and *debility* of the *pulse*; the *blueness* of the *lips* and *coloured parts* of the skin, were very observable in a minute, or a minute and an half. Besides, *dizziness* was felt, and the *eyes* have grown *dim*; in animals, the transparent cornea has appeared sunk and shrivelled, the skin has become flaccid, and the body was as it were collapsed. Several individuals agree in describing the incipient insensibility produced by the hydrogen air as highly agreeable. During this process, I have felt the *pulse* nearly *obliterated*. Afterwards, as the persons have recovered, it becomes sensibly *fuller* and *stronger* than before the inspiration. This fact, continues Dr. BEDDOES, belongs to a general principle now beginning to be understood; WHEN THE ORDINARY POWERS HAVE BEEN, FOR A SHORT TIME, WITHHELD FROM THE BODY, THEY ACT WITH GREATER EFFECT, as holding the fingers to the *fire* after handling *snow* occasions severe aching.

In a late publication \*, says that ingenious physician, we find many experiments, which confirm the opinion here advanced, that the unrespirable airs destroy by disarming the system of its moving principle, yet do they at the same time tend to refute the idea of those, who

\* *Considerations on the Medicinal Use of Fætitious Air, &c.*

have supposed, that they produce this deleterious effect *solely* by the exclusion of the oxygen of the atmosphere. Between these airs there seems a remarkable difference in their power to produce insensibility and death. Hydrogen, or inflammable air, appears the least noxious, both when inspired alone, or mixed with atmospheric air. Azote comes next; then fixed air; and the hydrocarbonate appears extremely active, and I presume, adds Dr. BEDDOES, that for recovery from asphyxia in water (when but little goes down the wind-pipe \*) hydrogen air and azote will be much more easy, than from as-

\* As the intention of this work is to set forth TRUTH, and not to combat *erroneous opinions*, the reader will not be surpris'd to find this question, "Whether the introduction of water into the wind-pipe is, or is not, the immediate cause of death in drowning?" as mentioned by DE HAEN, and others, wholly overlooked in the Section professedly treating on the recovery of drowned persons. We will however consider it for a few moments in this place. If an artificial *dropsy of the chest* be produced by injecting two ounces of water into the lungs, through the wind-pipe of a healthy animal, it immediately causes oppression, and difficulty of breathing, but no fatal asphyxia ensues: but the water is gradually absorbed, and the symptoms soon disappear. In drowning, the case is very different, since a few minutes submersion is sufficient to destroy the life of the animal, even whether water enter the wind-pipe, or not, for in many cases none is found in the lungs after death. This is decisively proved by the justly celebrated Dr. GOODWIN. He placed animals in quicksilver and in ink, and so little of this weighty metal or coloured fluid was found in the lungs as left no doubt of it not being the proximate cause of drowning. In one experiment after expiration the animal was drowned in ink, and no fluid whatever was found in the lungs. Vide Dr. GOODWIN's *Essay on Life as connected with Respiration*, to which was adjudged the gold medal.

PROPTER optimam DISSERTATIONEM DE RESUSCITATIONE.

phyxia occasioned by other unrespirable mediums. It may be reasonably conjectured, that fixed air, and hydrocarbonate, act by combining with the oxygen already in the blood, as well as by its excluding this principle : and this conjecture is supported by the hydrocarbonate possessing a much less effect, when it has deposited some part of its charcoal ; as also from the alteration which it is found to produce upon the blood\*.

Mines and coal-pits are frequently infested with two species of noxious air. The first is termed by the miners *Choke-damp*, which is fixed air, which being specifically heavier than atmospheric air, occupies the bottom of the mine. The other is called the *Fire-damp*, which is inflammable air, and being ten times lighter than common air, ascends to the upper region of the mine. The former is probably formed from the *charry matter* in the bowels of the earth, the latter from a fine

\* Having, says this ingenious experimentalist, put two fowls, the one in *fixed air*, and the other in *hydrocarbonate* ; to my great surprise, I found in the *former* the same appearances as in drowned or strangled animals, only the liver appeared a shade paler. But in the *latter* the whole flesh was throughout of a *light pink* colour when boiled, and the marrow of a fine *red*. The *former* tasted nearly as usual, the *latter* was certainly much more tender. Other acids, beside the carbonic acid, produce the same change on *venal blood*, rendering it of the *arterial colour*. The *hydrocarbonate air* is the happy discovery of the ingenious Mr. WATT, one of the first chemists of the age.

*aqueous exhalation*, and spontaneous *decomposition*. But *here* we are to consider the *manner* in which *these evils* are to be remedied, rather than the mystery of *their formation*.

To obviate the *fire-damp*, miners are in the habit of crawling on their hands and feet, and with a taper affixed to a long stick for setting fire to the inflammable air\*, which sometimes goes off with a terrible and sometimes fatal explosion.

With respect to the *choke-damp*, no means has yet been devised but *ventilation*, it being supposed to be stagnated air.

With respect to the mode of *ventilation*, and the *correction* of *this species of air*, we will offer but a few words.

\* Some years back a scheme was projected at WHITEHAVEN to light up that town by means of the *inflammable air* in the pits, which was to be conveyed by pipes throughout every street. As chemistry advances, may not the water of the THAMES be *decomposed* in certain appropriated places, and the *inflammable air* conveyed throughout the Strand and City, and this part of the town be *splendidly illuminated* each night at a very moderate expence?—Since the discovery of the nature of *combustion*, and the constituent principles of water, it is hoped that the candid reader will not consider this hypothesis as a mere rhapsody. Were a person to survey London *now* illuminated as it is by *Argent's lamps*, and the product of the *Greenland fisheries*, and compare it with what it was *five hundred years back*, and he will perhaps feel inclined to extend his views on the prospect of *future improvements*!

A shaft,

A *shaft*\*, as it is called, should be carried down somewhat slanting, and the funnel conveyed to the bottom of the pit, whereby the heavier and purer air from above would descend; while a perpendicular shaft, or chimney, with its mouth arising from the top, would carry up the lighter and corrupted air together with the inflammable.

Should

\* Vide Vol. I. page 67. It is curious to observe the knowledge which our ancestors had of the nature of air. RAY, in a work, entitled *The Wisdom of God manifested in the Works of Creation*, written in the last century, says, page 73, in speaking of *air-shafts*, "Indeed, were there no damps in mines, yet the *nitrous part*" (the NITROGEN or OXYGEN as it is now called) "of the air being spent and consumed by the breathing of the miners, the *remaining part*" (the AZOTIC) "would be unfit for respiration, unless new and fresh air were to succeed."—In another place he says, page 72, "The air is the fuel of the VITAL FLAME, without which it would speedily languish and go out."—Again he says, p. 73, "*Fishes*, and other *water animals*, cannot support life without it, for if you put your hand or any cover over a vessel containing fish, so as wholly to exclude the air, they will be suddenly suffocated."—Again, page 74, "Neither is it less necessary to *insects*, for if you put oil upon them, so as to obstruct those orifices that draw in air, if you obstruct only some, the parts that are supplied with air from them are shortly deprived of MOTION, while the rest of the parts that are untouched retain it."—Again, page 75, he says, "I am persuaded, with my learned friend Dr. HULSE, that the chief use of the circulation of the blood, through the cotyledons of a calf in the womb (which I have often dissected), and by analogy through the *placenta uterina*, seems to be THE IMPREGNATION OF THE BLOOD WITH AIR" (he has above explained the species of air) "for the feeding the *vital flame*: for if it were only for nutrition, what need of two such great arteries to convey the  
" blood

Should *fixed air*, notwithstanding this, stagnate in some parts of the pit, an engine, such as they water gardens with, should be used to *absorb* the *fixed air*, or else water should be kept continually boiling; for as the steam condenses, it would become *impregnated* with the *fixed air*. This ought constantly to be observed, where *charcoal fires* are employed. A tea-kettle boiling by the side would obviate the chief, if not the whole, of the evil.

In the *Hist. de L'Academie des Sciences*, Anno 1710, we are told of a baker of *Chartres*, going along with his son, a robust young man, into a cellar 36 stairs deep, who followed him with a candle, the candle went out on the middle of the stairs. Having lighted it afresh, he was no sooner got into the cellar, than he cried out for help, and they heard no more of the son or father. His brother, an able youth, ran immediately after him, cried out he was dying, and was heard no more. He was followed by his wife, and she by a maid, and still it

“ blood thither? Secondly, I have observed the *umbilical vessels* to terminate  
 “ in a multitude of *PAPILLÆ*. Now these *PAPILLÆ* do resemble the  
 “ *RADII* of a *FISH'S GILLS*, and most probably have the same use, viz. TO  
 “ *SECRETE AIR*, and convey it to the *fœtus*, so that the *fœtus* in the womb  
 “ doth resemble a fish in its mode of living, or else why should there be such  
 “ an instant necessity of *respiration* so soon as the *fœtus* is fallen off from the  
 “ womb?”

WAS



was the same. Such an accident struck the whole neighbourhood with a panic, and no one was forward to venture any farther, till a fellow, more hardy and zealous than the rest, persuaded that the five people were not dead, would go down to give them help. He cried too, and was heard no more. Upon this a *sixth man*, taking with him a hook, drew the last of them forth without going to the bottom, who, fetching a deep sigh, died. Next day the baker's friend, undertaking to get up all the carcases with the hook, was let down with ropes. He called out, and in the haste the rope breaking, he fell into the cellar, and was dead. The magistrates, taking cognizance of the case, the physicians were consulted, who advised a good deal of *water* to be thrown down. This being performed, a dog and a lighted candle were let down without injury to either, and the dead bodies in this cellar were taken out.

There is a small *grotto* at the foot of a little hill, about 8 feet high, 12 long, and 6 broad; from the ground there arises a thin subtle fume visible enough to a discerning eye, which does not spring up in little parcels here and there, but is one continued stream, covering the whole surface of the bottom of the cave; and has

\* Called *Grotto del Cani*.

this remarkable difference from common vapours, that it does not, like smoke, disperse itself into the air, but quickly after its rise falls back again, and returns to the earth; the colour of the sides of the *grotto* being the measure of its ascent, for so far it is of a darkish green, and higher only common earth, and therefore we find no inconvenience by standing in it; and so no animal, if its head be kept above this mark, is in the least injured. But when a dog or any other creature is forcibly held below it, or by reason of its smallness cannot hold its head above it, it presently, like one stunned, loses all motion, falls down as dead, or in a swoon, the limbs are convulsed and trembling, till at last no more signs of life appear than a weak and almost insensible beating of the heart and arteries, which, if the animal be left there a little longer, quickly ceases too, and then the case is irrecoverable; but if snatched out, and laid in the open air, it soon comes to life again, and sooner yet if thrown into the adjacent lake.

The *Russians* and *Germans* are frequently exposed, during their cold season, from the *noxious air* of their stoves, and want of due ventilations.

As soon as a person with them is discovered to be deprived of sense and motion, he is stripped naked, and

brought into the *open air*; where he is rubbed with *snow*, or *cold water* is dashed repeatedly over the surface of his body.

To attempt to restore *lost heat*, by the application of cold water, or snow, must appear preposterous folly to those who have long been in the habit of applying *artificial heat*; whether the sufferer is drowned under the thick ice, or suffocated by inflammable air; bleached by the drifted snow; or scorched by the vivid rays of lightning.

How can we reconcile this practice in such different cases to the suggestions of common sense! Shall we, with JOHN HUNTER, say, that *cold* is suited to the *feeble power* of life; or with JOHN BROWN, that it is adapted to the *accumulated irritability* of the fibre. Undoubtedly, the method above stated is universally practised throughout the north, even with the *common people*, and with *constant success*, where respiration has not been suspended above an hour\*. This is an *argumentum crucis*, that all parties must ultimately acquiesce in, however they may choose to explain the fact.

\* Vide Dr. FOTHERGILL's *Enquiry into the Suspension of Vital Action in Cases of Drowning and Suffocation*, page 136, a work that has been repeatedly spoken of, and praised for its great *ingenuity* and *candour*.

## SECT. L.

## OF ASPHYXIA FROM HANGING.

IF death was nothing, and *nought* after death ;  
 if when men dy'd, at once they ceas'd to be,  
 returning to the barren womb of nothing,  
 whence first they sprung—Then might the wretch  
 that's weary of the world, and tir'd of life,  
 at once give each inquietude the slip,  
 by stealing out of being, when he pleas'd,  
 and by what way ; whether by *hemp*, or *steel*.  
 Death's thousand doors stand open.—Who could force  
 the ill-pleas'd guest to sit out his full time,  
 or blame him if he goes ?—Sure he does well  
 that helps himself, as timely as he can,  
 when able.—But if there is an *hereafter*,  
 and that there is, CONSCIENCE, uninfluenc'd  
 and suffer'd to speak out, tells every man ;  
 then must it be an *awful thing* TO DIE :  
*more horrid yet, TO DIE by one's own hand.*  
*Self-murder !—dreadful deed !—our island's shame :*  
 that makes her *the reproach* of neighbouring states.  
 Shall NATURE, swerving from her earliest dictate  
*Self-preservation*, fall by her own act ?  
 Forbid it heaven !—Let not, upon disgust,  
 the *shameless hand* be foully crimson'd o'er  
 with blood of *its own Lord*.—Dreadful attempt !  
 Just *reeking* from *self-slaughter*, in a *rage*  
 to *rush into the presence* of OUR JUDGE ;  
 as if we challeng'd him to do his worst,  
 and heeded not his wrath.—

BLAIR.

From what has been already observed, it seems evident, that whether death is brought on by *submersion*, or *noxious air*, the effects produced on the animal body are so nearly *similar*, that these several modes of death may not improperly be referred to the *same common cause*. But with respect to the effects of *hanging*, most authors have inclined to the side of APOPLEXY, and this is much insisted on by Drs. CULLEN and BOERHAAVE, and of late by Mr. KITE; and as a *difference in theory* cannot but *influence practice*, it therefore demands the most serious investigation.

It is observable, that in APOPLEXY the irritability continues several hours,—while in *drowning* or *hanging* the animal functions are abolished in a few minutes.

In APOPLEXY, respiration, together with the action of the heart and arteries, go on, and the pulse often vibrates more forcibly than in health.—In HANGING, or DROWNING, respiration is suppressed, and the pulse obliterated.

In apparent death from APOPLEXY, very few recover, and those few generally become paralytic.—In vital suspension from DROWNING or HANGING, many are restored, and yet no palsy supervenes\*.

\* Vide PART V. Sect. on *Apoplexy*.

In cases of *apparent death*, an APOPLEXY indeed may sometimes occur, not as a certain consequence, but as an *accidental circumstance*. Thus in HANGING, if the person shall leap from an height to accelerate his death, it may produce a dislocation of the vertebræ of the neck, or an extravasation of the brain. Thus in DROWNING, if the person shall have fallen from any height, and receive a contusion on the head, and yet after all life be restored, it is no wonder if PALSY supervenes, a circumstance, however, by no means frequent in other cases of restoration from apparent death.

In a word, the TWO CASES, upon the first view of things, appear to be *totally different*, and to require a *very different mode of treatment*.

In the *latter*, copious bleeding affords the principal relief; in the *former*, it generally proves highly injurious\*.

\* In March 1781, the MEDICAL COMMITTEE entered their *Caveat* against the use of the lancet. And Dr. HAWES wisely admonishes, that it should never under such circumstances be ventured upon, except in habits highly plethoric, or where some contusion has been received.

—————Si Pergama dextra  
defendi possent, etiam hac defensa fuissent.

VIRG.

Vide Mr. KITE's laboured *Essay on the Recovery of Persons apparently drowned*, to which was given the *silver medal*.

PROPTER *eruditam* DISSERTATIONEM DE RESUSCITATIONE.

The



The *wind-pipe* of a dog, says a very acute and ingenious experimentalist, Mr. COLEMAN, was secured by a ligature at the instant of inspiration; in less than *four minutes* he ceased to struggle. Here there was *no obstruction* to the passage of the blood *through the lungs*, and *no accumulation* was found in his *head*; yet he died in this short space of time.

We next secured, says he, the two carotids\* of a dog (which we know, from the experiments of M. EMETTUS and Mr. KITE, may be done without materially injuring the functions of the animal). In half an hour after this operation he was hanged. In less than four minutes he ceased to move. The vessels of the brain, upon accurate inspection, were much *less distended* than in *ordinary death*. Here the principal supply being cut off, instead of the vessels of the brain being in a state of *congestion*, they contained a much *less quantity* of blood than *natural*, and consequently no species of APOPLEXY could follow *from distention*, and yet this animal died *as soon* as others which had undergone no such operation†.

\* Vide the Map of the Heart, Vol. I.

† Vide Mr. COLEMAN's excellent *Dissertation on Suspended Respiration*, a work replete with ingenious experiments, and honoured with the gold medal.

The following experiment, which was made by that eminent anatomist and teacher at Edinburgh, Professor MUNRO, is, we think, decisive on this head.

*A dog was suspended by the neck with a cord; an opening having been previously made in the wind-pipe below the cord, so as to admit air into the lungs. In this state, he was allowed to hang three quarters of an hour, during which time the circulation and breathing went on without being much interrupted by the experiment. The cord being now shifted below the opening into the wind-pipe, so as to intercept the ingress of air into the lungs, the animal was completely dead in a few minutes.*

Now, admitting these facts, is not the conclusion obvious, viz. *that in cases even of HANGING, death is not occasioned by a CONGESTION OF BLOOD in the brain; but from the want of the VITAL PRINCIPLE in the blood?*

For the Plan of Treatment we must therefore refer the reader to what has been said in SECTION XLVIII.  
ON ASPHYXIA FROM DROWNING.

## SECT. LI.

## OF ASPHYXIA FROM MENTAL AGITATION.

—Ubi vehementi magis est percussa metu mens,  
 concentire animam totam per membra videmus;  
 sudores itaque, et pallorem existere toto  
 corpore, et infringi linguam, vocemque aboriri,  
 caligare oculos, sonere aures, succidere artus.

LUCRETIVS.

IN excessive fright the eyes for a moment flash fire; the hair becomes electric and stands erect; the heart palpitates; the body is thrown into the attitude for escaping; but the danger being inevitable, cold sweats succeed; the hair of the body droops; the eyes become dim, and as it were semipellucid; the surface flaccid, cold, and pale; and the person sinks down inanimate.

Admitting the analogy, if not perfect identity betwixt the *nervous fluid* and that of *electricity*\*, we can account for

\* Sir ISAAC NEWTON, at the end of his *Principiæ*, has the following Query. "Is not all *sensation* performed, and the *limbs* of *animals* moved, in "a voluntary manner by the power of a certain *subtle fluid*, resembling "ELECTRICITY, which we will call *æther*, i. e. by the vibratory motion "of *this fluid*,—propagated along the nerves from the *external organs* of the "senses

for one part of the appearances. Upon what other principle can we explain the power that can make

the knotty and combined locks stand an end  
like quills upon the fretful porcupine ?

Whence otherwise shall we account for those fiery scintillations of the eye first excited upon a sudden alarm ? And whence that succeeding dimness, when the hairs of the body subside, and the limbs sink down powerless ?

The phænomena of blood-letting will serve us to explain the other symptoms. I bled, says Mr. HUNTER, a lady whose blood at first was of a *dark colour* ; but she fainted, and while she continued in the fit, the colour of the blood that came from the vein was of a *bright scar-*

*“ senses TO the BRAIN ; and FROM the BRAIN into the muscles.”* “ If a man in the dark,” continues Sir ISAAC NEWTON, “ presses against the corner of his eye, or receives a blow, as he turns away his eye hastily from the injury, he will perceive a circle of colours, or a *flash of light*, and this appearance will continue about a second of time.” Vide his OPTICS, Qu. 16. It was before observed, that if a plate of zinc be placed between the gums and upper lip, and a plate of gold be brought into contact with the zinc, a *similar flash of fire* will be perceived ; and if this experiment be tried on the tongue an acid taste will be experienced similar to that of the *electric aura*. Vide VOL. I. p. 116 ; also VOL. IV. the Section on the Brain.

When we are in the dark, says the eloquent BURKE, in his Essay on the Sublime and Beautiful, there is a continual endeavour of the pupil to receive light. Hence arise those *flashes and luminous appearances*, which often seem in these circumstances to play before it, and which can be nothing but the effect produced by the nervous fibres in their efforts to obtain its proper object of vision.

*let.* Mr. HEWSON observes also the power of the mind, as he terms it, of altering the character of the blood, and of three small cups, the first shall sometimes contain *florid* blood, the second *venal*, and the third *florid* again; but in animals that are bled to death, I always, says this accurate experamentalist, found that the *venal blood* became *brighter* in proportion as the animals became faint and it *coagulated* the more\*. Might not the violent palpitation of the heart; the hurry of the circulation; the retrograde motion of the absorbents; the coldness and paleness of the skin; the inability for muscular action, &c. depend upon the minute arteries not giving out their *oxygen*, as is manifest from these experiments? If so, it will further confirm the doctrines contained in Vol. I. of this work †.

Hence it will be proper to allow the swooning patient to remain in the state of *quiescence*: for during *this torpor* the IRRITABLE PRINCIPLE will accumulate in the fibres, and by degrees the just *balance* will be restored betwixt the *excitability* and the *natural stimuli*. To

\* From possessing more OXYGEN, *i. e.* the principle of life.—Dr. BEDDOES.

† The *pulsation* of the heart and arteries; the *powers* of the stomach; the *colour* and *warmth* of the surface; the ability for *muscular action*; was shewn to depend on OXYGEN in Vol. I. Sections V. VIII. XIII XII.

accelerate recovery, the person ought however to be exposed to

that VITAL BREEZE, which NATURE pours to save the breathless victim from the untimely grave;

and the forehead should be rubbed with *vinegar*\*, which ought also to be sprinkled all around the swooning patient; or the real *oxygen air* might be placed against the mouth and nostrils, while water is poured into the bottle; and the hands and face should be rubbed with *cold water*.

That *irritability* is *accumulated* during the operation of terror, we have the following proof. A gentleman, having hastily dismissed a servant of an implacable disposition, was alarmed in the middle of the night by an attempt on his house. His wife, who had been always apprehensive of the villainous principles of this servant, was so terrified, that she started from her bed, lost the power of utterance, and laid hold of the curtain for support, being seized with violent shiverings. This continuing for some time after she was got into bed, I was sent for, says Dr. CORP of Bath, and when

\* Fermented liquors, when exposed to *heat* and *air*, absorb VITAL AIR, and become in consequence *vinegar*. Being sprinkled in fine sprays, it is rendered *aeriform*, and parts with its OXYGEN when it comes into contact with the *animal fibre*.



I came to this lady, her appearance was lifeless ; her face and extremities cold and pale. As with the paroxysm of an intermittent fever, a very considerable degree of *heat*, succeeded the *trembling fit*, which lasted many hours with great restlessness, until a *profuse sweat* broke out, when she fell asleep, and, as after an attack of ague, she rose up the next morning exceedingly languid\*.

\* Vide Dr. CORP's ingenious *Essay on the Changes produced in the Body by Operations of the Mind*.

## S E C T. LII.

## OF ASPHYXIA FROM OPIUM.

I know the power of PREJUDICE in favour of old erroneous doctrines; and how great the *resistance* is even to the *most certain* and *luminous experiments*. PREJUDICE has certainly a great share in this *repugnance*; but above all SELF-LOVE dreads to adopt *new truths*, because *they* carry with them a tacit avowal of *ignorance*;—hence arises the difficulty of bringing those who are *advanced in years*, and *men of learning* who have already acquired reputation, to admit of NEW DISCOVERIES.

FONTANA.

THE attention of physicians has deservedly been turned towards OPIUM; in order to ascertain its salutary operation on the animal œconomy, and its powers as a poison. After having been so long employed, it may seem surprising, that any contrariety of opinion should exist among liberal minds; but some still deem it altogether *sedative* in its operation; others *stimulant*; and others again both *stimulant* and *sedative*. This controversy appears to have its rise from the difference in *effect* which takes place according as it is administered.—As a *stimulant* it stands before *wine*, and has nearly the same operation. WINE quickens the pulse, raises the spirits, increases vigour, and gives more than common anima-

tion for the time ; but no sooner are the fumes of the intoxicating drink exhausted, than the drunkard becomes weak, enervated, and depressed in spirits. Here we distinctly see both the *stimulant* and *sedative* power of wine ; and the same exactly holds with regard to *opium*. Thus if any one is under the pressure of sleep, he will by *OPIMUM* be rendered surprisingly sprightly, lively, and vigilant\* ; it banishes melancholy ; begets confidence ; converts fear into boldness ; makes the silent eloquent ; and dastards brave. Has it not the same effect upon the Turks, that *wine* has upon us ? Or are we to suppose, that the troops of that people, on their march to the onset of battle, chew *opium* with the intention of checking their natural alacrity and propensity to action, and of blunting and depressing their high spirits and courage ? But after a while, the *excitability* becomes *diminished* in quantity, being *expended* by the great activity of the system ; and hence, when the stimulus of the opium ceases, the fibres will not obey their *natural stimuli*, and a *consequent torpor* ensues, as is experienced by drunkards, who, on the day after a great excess of spirituous liquor, feel *tremor*, *head-ach*, and *general debility*. During *this torpor* an *accumulation* of *excitability* in the exhausted

\* Vide Vol. II. page 332.

fibres takes place, which is frequently so great as to occasion a second *over-exertion* from even the *ordinary stimuli*, and thus an *unequal balance* of the *excitability* and *natural stimuli* may continue for two or more days.

But where the dose first administered is *great*, its *sedative effects* are almost immediately perceived. By a solution of opium, injected into the stomach of a frog, while the transparent membrane of its toes was under a good microscope, the dose being *small*, there was at first an *increase*, and afterwards a *diminution* of the blood's velocity. By a second and larger dose, given an hour after the first, the blood was seen to move immediately *slower*, and its velocity *gradually decreasing*, it stagnated at length, and the animal expired.

A solution of opium injected into the intestines of a dog, brought on palsy of his posterior extremities, attended with convulsions and stupor.

Some days after, when the dog was recovered, the like solution was injected, by a perforation through the integuments, into the abdomen of the same dog: he became paralytic instantaneously, and died in a few minutes.

We are now to enquire, *by what channel does opium act?*—Seeing the many *erroneous opinions* that have prevailed,

veiled, we should be careful how we suffer ourselves to be led away by *great authorities*, and should bow our assent only to *facts*, and *such conclusions* as naturally result from them. It was proved before, that *irritability* was distinct from *sensibility*, and how much these properties depend upon a due *oxygenation* of the *blood*, was also clearly explained\*.

We are to enquire, “*whether opium acts by means of the BLOOD on the irritable fibre,*” as was before proved with the *Ticunas*, the American vegetable poison, or “*has its operation solely on the NERVES.*”

Notwithstanding it appears certain, that opium, even when simply dissolved in water, whether it is introduced into the stomach, or into the intestines; whether it is injected beneath the skin, or into the abdomen; whether it be applied to the heart or muscles; equally acts on the animal body: yet a doubt still remains whether its action and energy are wrought on the *nerves*, or whether it needs the vehicle of the *blood*, and the circulation, to give it activity.

We have seen that the venom of the *viper* acts in no other way than by the medium of the *blood*; and the

\* Vide Vol. I. Sect. XXXII. p. 340, and Sect. XXXIV. p. 359.

vegetable poison of the *ticunas* appears to act in *the same manner*\*. It is certain that all poisons, as well as *opium*, kill when swallowed; but this does not prove that their action is wrought immediately on the *nerves*†, and that they do not employ the medium of the *blood*. There are we know in nature principles attractive and destructive of each other, and may not the subtle and active particles of a poison, penetrate from this law of affinity, and introduce themselves into the blood? We are under the necessity of admitting unknown powers, of whose principles and mechanism we are ignorant. We allow that iron is attracted by the magnet, though we are wholly ignorant of magnetism. Thus the difficulty which arises from the mortal effects of opium when taken internally, does not prove that it acts im-

\* Vide Vol. II. p. 389.

† 1st. FONTANA divided the *nerves* going to the leg of a rabbit, it was rendered *insensible* and *paralytic*. He then applied the venom to the leg, and though the *nervous influence* was intercepted, it communicated all the symptoms of the poison of the viper.

2d. On the contrary, when the *veins* and *arteries* going to, and returning from, the leg where *intercepted*, and the poison inserted, it did not communicate the disease of the venom of the viper.

And 3d. When the *nerves* were separated from the body, and surrounded with venom, it produced no symptoms of this disease. Vide Vol. II. page 396.

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mediately



mediately on the *nerves* ; and besides it has been demonstrated, that the venom of the *viper* and *ticunas* have no immediate action on the *nerves* themselves\*.

To be enabled to make some very probable assertion on this difficult matter, an experiment must be imagined in which opium may act freely against the nerves, without the smallest introduction of it into the *blood*, or rather, without its touching the *blood-vessels*. Such an experiment, considering the dexterity and precision it requires, is not one of the easiest to make, and can be only well tried on very small animals, and on a very few of the nerves. To obtain certain consequences, and such as do not proceed from deceitful and variable experiments, it was necessary to make a great many trials, to exclude all the results that accidental circumstances might have rendered imperfect, to compare the different consequences with each other, and to weigh them in each case, with those of the experiments intended to serve as comparative ones.

I destined, says FONTANA, 300 frogs for these experiments, and by means of pincers and scissars, I laid bare the *cruial nerves* in such a manner as they were

\* Vide Vol. II. p. 396.

entirely free of every other part, and obtained about eight or ten lines of nerve totally clear, and in some very large frogs even more. I then let fall the nerves of each thigh into a small hollow glass, which receives them in such a way, that I can fill each glass with a fluid of any kind without its touching the adjacent muscles. I usually have been able to put into these glasses such a proportion of whatever I wish to try on the nerves, as to cover the greater part of them with it, without its being possible for any of the liquor to find its way to the thighs, and mix with the blood. In this way I can make a comparison betwixt the nerves that are envenomed, and those that are not, compute the time that they continue to contract the muscles, and judge of the vivacity of the motions.

At the end of the first *ten minutes*, I stimulated the medicated nerves; I shall distinguish in this way those to which I applied the opium, and those which were not medicated, and found that the two extremities, the right as well as left, contracted with the same force and vivacity.

At the end of *twenty minutes*, I tried the stimulation, and could perceive *no sensible difference* betwixt the mo-

tions of the two feet, which were almost as lively as those in the first experiment.

At the end of *thirty minutes*, the motions of the two feet were feebler, but *alike* in both.

At the end of *forty minutes*, the feet scarcely contracted; but their distinct muscles were clearly seen to contract, when the crural nerves were stimulated; and the motions of these muscles were *equally* lively in each foot.

At the end of *fifty minutes* the motions were very small, but *alike* in both sides.

At the end of *eighty minutes* there was no longer any motion to be observed in several of the frogs, in whatever way I stimulated either their crural nerves that were medicated, or those that were not so.

I can conceive, adds FONTANA, nothing more decisive and more certain, than from this series of experiments, that the action of OPIUM is not directly on the nerves, and when I related these experiments to Sir John PRINGLE, he very frankly told me, that for his part  
 “ he had never too great a belief in the explanation given  
 “ of NERVOUS DISEASES, and that for the future  
 “ he should have less faith in the doctrine than ever.”

In

In order to make this point still clearer, I wished to see, whether opium, when injected into the vessels, causes death, and whether it produces the same derangements in the animal œconomy, when introduced into the circulation of the blood, as it does when swallowed, or injected into the different organs and viscera.

I injected about eighteen drops of the aqueous solution of opium into the jugular vein of a large rabbit. It was scarcely injected when the animal felt drowsy, could no longer support itself, and fell down. It, however, recovered in a few hours, and became perfectly well.

I next injected a tea-spoonful of the same aqueous solution into the vein of another rabbit, and it died *instantly*.

I repeated this experiment on a third rabbit, with the same quantity of solution, and it died also at *the moment* of injection.

Thus then *opium*, injected into the veins, produces heaviness, and even death itself. *Wine* or *alcohol* produces, as I found, pretty nearly the same effects.

I conceive it to be altogether superfluous to relate a greater number of experiments on opium, injected into  
the

the jugular vein, and introduced into the circulation, without its touching any of the wounded solids. When once it is received into the vessels, I do not see how it can communicate itself in an immediate way to any of the *nerves*, since all-prying anatomy assures us that the coats of the blood-vessels are not furnished with any *nerves*, and we have a further confirmation of this point from an experiment made by the celebrated professor of anatomy at Edinburgh. I found, says Dr. MONRO, when I poured a solution of opium under the skin of the thigh and leg of a living frog, not only the leg itself was very soon affected, but the affection was communicated to the *most distant part* of the body: but if, previous to the application of opium, I cut out the heart, or cut across the femoral blood-vessels, the effects of the opium were not communicated from that limb to *distant parts*,—which seems to prove how much the circulation of the blood, and the fluid of the machine, is the vehicle for opium, and that without this fluid it would have no action on the living body.

Another argument to prove, that the action of opium is on the *irritable fibre* through the medium of the *fluids*,  
is

is shewn from its power over *vegetable productions* \*, and those parts of the body which are *irritable*, and have been *separated* from its *communication* with the *brain*. Having cut out the heart of a young kitten, says Dr. James JOHNSON, it notwithstanding continued its natural movements in a very lively and regular manner. In that state I put it into a tea-cup containing some laudanum: in a moment the pulsations of the heart ceased, and could not be removed by any kind of stimulus.

Having divided the heart of another kitten into two *pieces*, out of the body, one of them was thrown into laudanum, a little diluted with water, and it soon lost its pulsatory motions, and stimuli had no power or effect in restoring them: but *the other half* of the heart, lying at the same time upon the table, contracted very briskly whenever it was touched with the point of a needle or a knife, and that long after the part steeped in diluted laudanum remained immoveable.

The same events happened to a piece of *intestine*, cut out, when dipped in laudanum: the peristaltic motions,

\* The analogy betwixt these two kingdoms of nature have never been sufficiently scrutinized. This subject has of late engaged the attention of Drs. GIRTANNER, GAHAGEN, INGENHOUZE, THORNTON, &c. Vide Vol. III. p. 411.

which



which were brisk before, ceased instantly, and could not be removed by stimuli: yet *another piece* of the small gut, cut out, lying on the table, continued to move and twist itself with great vivacity when it was stimulated.

Does not OPIUM then act upon the *muscular fibres* through the medium of the *blood*? Does not the motion and power of these fibres, depend upon their union with OXYGEN, chiefly taken into the body by respiration, and diffused by the circulation of the blood? And does not its *action* consist in *disuniting* the OXYGEN from *these fibres* so rapidly, by changing the law of ELECTIVE ATTRACTION \*, as to extinguish their *vitality*, before they can have a fresh and adequate supply of VITAL AIR?—The sudden extinction of life, and the state of the body after death, entitled the ingenious Dr. BEDDOES to make these suggestions; and start an opinion, which an enlightened and reformed system of physic will soon, perhaps, satisfactorily elucidate.

Mr. Y——, of the age of fifty years, took by mistake, at bed-time, about ten drachms of laudanum: he had a fit of the gout at the time. No alarm was given till about four o'clock next morning, when excessive

\* The nature of the LAWS OF AFFINITY, or ATTRACTION, has been before explained, Vol. I. p. 13, and Vol. II. p. 225.

drowfiness and languor came on: after that he took repeated doses of the OXYD\* of ANTIMONY, by which some of the laudanum was rejected by vomiting.

I saw him, says Dr. James JOHNSON, about nine the same morning: his paleness, languor, and lethargic disposition, were very great; his pulse beat languidly, about thirty-eight strokes in a minute. By stimulating his throat with a volatile embrocation, he was empowered to swallow a cathartic†: blisters were applied to the back and arms; and sinapisms to his feet. He took, by my direction, coffee frequently, and after each dose of it, a desert spoonful of VINEGAR‡. He was also carried out, and well shaken in a post chaise on a rough road. About four o'clock in the afternoon, he was so much roused, that his pulse beat at least seventy strokes in a minute. The dangerous sedative power of this enormous dose of opium was thus obviated, and his brain put into such a state of vigilance, that the ensuing evening he passed a restless night. He then returned to his usual state of health.

\* For an explanation of this term, vide Vol. I. p. 11.

† Probably containing also some METALLIC OXYD.

‡ Vinegar owes its acidity to the absorption of VITAL AIR.

We have a case still more to our point in a letter from Major BRATHWAITE to Dr. BEDDOES, in Part III. of *Observations on the Medicinal Use of Facilitious Airs, and their Production.*

TO DR. BEDDOES.

STRETTON-STREET, July 24, 1795.

SIR,

Having, for a considerable time been troubled with Rheumatic pains, it was recommended to me to take a mild opiate every night on going to bed, and in the event of that dose not proving sufficiently soporific, I was to add to it a few drops of laudanum, for which purpose I had procured a two-ounce phial of laudanum. Nevertheless, being unwilling to accustom myself to the use of opium, I generally postponed taking the opiate till extreme pain and want of sleep rendered it absolutely necessary. In one of these moments, about four o'clock in the morning, I reached out my hand to the night-table, on which, by mistake, my servant had placed the phial containing the two ounces of laudanum, and believing this to be my usual night-draught,

I poured the contents into a tumbler glass, and drank it off. I soon perceived my mistake by the taste of the laudanum, but from my immediate relief from pain, accompanied by a certain pleasing languor, it was some time before I could rouse myself so as to call assistance. Being, however, perfectly convinced that I must soon beat a quick march to the other world, unless my stomach was eased of the poison it contained, I rang the bell, and ordered some warm water. It was some time before this could be got ready. As soon as it was brought I drank large quantities, but without any apparent effect. The apothecary was then sent for, who gave me several different doses of VITRIOLATED ZINC \*, when at last they succeeded so well, that I brought up a considerable quantity of the laudanum. In the morning early I sent for Dr. THORNTON, who administered the VITAL AIR †, and ordered me LEMONADE ‡, which, from the weak state of my stomach, was almost as speedily returned, but perfectly *sweet* to the taste, and

\* This metal, like the rest, has no power, until it be combined with *oxygen*.

† Dr. THORNTON, in his observations on this case, remarks that the VITAL AIR was very rapidly consumed, which must recall to the reader's mind the celebrated experiment of SPALDING, recorded in Vol. I. p. 89.

‡ A mixture of lemon, sugar, and water.

so deprived of all *acidity*\*, as to be like sugar and water. This was frequently repeated, when in the evening I ate my dinner, without any sensible difference, and felt the next day much as usual. This is the simple fact, to the best of my remembrance; if it can be of any use in a science, which has for its object the ease and happiness of mankind, I shall always look back with pleasure to an accident which has afforded me an opportunity of giving you this detail. I have the honour to be,

SIR,

Your most obedient Servant,

GEO. CHARLES BRATHWAITE.

\* The *acid principle* has been before proved to be derived from the oxygen, or VITAL AIR. Vide Vol. I. p. II.

## SECT. LIII.

## OF ASPHYXIA FROM THE BITE OF THE VIPER.

FONTANA made more than six thousand experiments upon the poison of the viper ; he employed more than four thousand animals, and the conclusion he draws from this enormous number of experiments, is, that this poison does not act on the NERVES, but on the IRRITABLE PRINCIPLE in the moving fibres, through the medium of the *blood*. Hence, in those animals that recover, the parts bitten are usually *paralytic*, but not *insensible*. He observes, that the venom of the viper produces a perfect *gangrene*, and the muscular parts are either *discoloured* or *pale* ; and that the *florid colour* of the blood also is wholly *destroyed* \*.

His experiments are very numerous respecting the antidotes against this poison. After reading two thick volumes of experiments, ingeniously devised, we are at last amply repaid by the account he gives us of the LUNAR CAUSTIC † ; that is, silver combined with OXYGEN.

\* Vide Vol. II. Sect. XXVI. p. 389.

† The *oxyd of silver* from the nitrous acid.



He had no theory that conducted him to the trial, and therefore cannot be suspected of having any bias on his mind. He mixed equal quantities of LUNAR CAUSTIC with the venom of the viper, adding thereto a few drops of water. I wounded with this mixture, says he, the legs of five small birds, *but none of them died, or seemed affected with the disease of the venom, and there was no gangrene or paralysis produced!* I tried this mixture on ten other birds, which added to my great astonishment. Still I could not determine as to the unexpected novelty of these favourable consequences; and fearing that accidental circumstances might have prevented the action of the venom, I resolved to make other experiments on the same animals. I wounded the legs of six others, multiplying the incisions, to introduce a good deal of the venom. In these experiments two of the birds actually died, one in the space of six hours, the other in twenty-eight. On the morrow, I repeated this experiment, with the same circumstances, on ten other birds; two *only* of them died, and that at the end of twelve hours. Fearing that the wounds alone might have brought on death, particularly as they were irritated by the caustic, I tried ten birds, on the legs of which I made wounds as usual, and applied the caustic by itself. One of them died

died at the end of eight hours. So it seems at least very probable, if not very certain, that the two birds before mentioned, died likewise of their wounds, and not of the effects of the venom.

The pigeon, next to small birds, particularly if very young, is the animal killed with the smallest quantity of venom. I chose four of these for a trial, and operated on all of them in the same way. I made several transverse wounds with scissars, in the muscles of their legs, and introduced this venomous liquor mixed with LUNAR CAUSTIC abundantly into the wounds. *Neither of these pigeons either died, or seemed to have the disease caused by the venom of the viper.* The next day I repeated the experiment on twelve pigeons, the legs of which I wounded in several places, and *neither of them died.* I varied the application of the venomous mixture, which I sometimes forced into the wounds with small bits of wood, sometimes with pieces of stout thread smeared with it. *Neither of them died* in these trials. I proceeded to the muscles of the breast, which I wounded in different ways, and diversified the application of the mixture: but it was in vain that I multiplied my experiments, *neither of the pigeons died!*

It cannot now be doubted, but that the LUNAR  
CAUSTIC,

CAUSTIC, when mixed with the *venom of the viper*, renders it INNOCENT; and thus every thing concurs to make us regard it as the *true* and *only specific* against this poison. I can now flatter myself, says FONTANA, with having at length discovered a *certain remedy* against the bite of the viper; a remedy that so many people have sought for in vain.

I next proceeded with confidence to try the LUNAR CAUSTIC after the bite or insertion of the venom had taken place. I wounded the muscles of the legs of four small birds, as birds are the easiest killed by the venom of the viper, and after having made slight scarifications, I applied the *lunar caustic*, washing the wounds soon after. *Neither of them died, nor had the disease of the venom.* I wounded next four other birds like the preceding ones, in the legs, with venomous teeth, and afterwards washed and scarified the wounds, but did not apply the *lunar caustic*. THEY ALL DIED. I then wounded eighteen birds, scarified the wounds, applied the remedy, and washed them, and THEY ALL RECOVERED!

I proceeded then to try this new remedy on six small Guinea pigs. To three of them I applied the venom to the muscles of the legs, to the other three, to those of the breast, each of which I had previously wounded. I  
then

then applied the LUNAR CAUSTIC. *Neither of the Guinea-pigs died.*

I began to vary my experiments. I had six fowls bit in the thigh by as many vipers. Five of them swallowed three tea-spoonfuls each of the solution of the *lunar caustic*, the other did not swallow any. I applied the *lunar caustic* in the same way to each of their wounds; the last *died*, and the other five who took the solution all *recovered*.

Among the multitude of other experiments, we find but *one other remedy* besides the *lunar caustic*, which was of any material advantage for the bite of the viper, and this serves also to confirm the theory maintained in Sect. XXVI. Vol. II. p. 389.

I observed, says FONTANA, that dogs and cats recovered in proportion to the violence of their vomiting. I wished to follow the indications of nature. The result of some of these experiment contradicted that of others, but several of them were very favourable and uniform. Amongst a great number of trials, I had, says he, a dozen dogs bit in the leg, each by three vipers, and by each repeatedly. To six I gave EMETIC TARTAR (*antimony combined with oxygen*), and to the other half nothing. All who had the emetic tartar *recovered*: and the others,

except two, soon *died*, so that I am inclined to think that emetics\* are of service, as seven or eight successive trials had not unfrequently the same successful termination.

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I had intended to have made no mention of poisons, which are uncommon, but there is one particular, respecting the vegetable poison, called *ticunas*, with which the American Indians fatalize their arrows, that I cannot help here relating it.

I dissolved, says FONTANA, this deleterious poison in the *three* MINERAL ACIDS, as also in distilled VINEGAR.

I made slight incisions into the skin of a small Guinea-pig, and wet it several times with the solution of the poison in *nitrous acid*. What the animal suffered seemed to result from the wounds and acid alone, for in an hour it became as lively as usual.

Two hours after, I repeated this experiment on an-

\* The query is, Whether any other emetic than a *metallic oxyd* would have had this effect?

other part of the skin prepared in the same way, employing a solution of the poison in *rum*, in less than four minutes the animal *died*.

I then wounded the skin of a small rabbit slightly, and applied to it several drops of a solution of the poison in *oil of vitriol*. The rabbit felt no ill effects from it.

I next prepared as usual the skin of a small rabbit, and wet it with a solution of the poison in the *dephlogisticated marine acid*: and the animal did not suffer from it.

I also made an experiment with the solution of this poison in *vinegar*.

Of six animals treated with the solution in *vinegar*, two died, two had all the symptoms of the disease caused by the poison, and the other two were not affected by it.

In these instances, we cannot suppose, says FONTANA, that the *mineral acids* prevented the effects of the poison of the *ticunas*; or the *lunar caustic* that of the viper; by crisping and hardening the blood-vessels, and thus preventing the poison from insinuating itself this way into the blood, for the *fluid volatile alkali* has no such property, and this must appear to us *strange*,



he adds, when we consider the great agreement there is betwixt the FLUID ALKALI and LUNAR CAUSTIC\*.

In India there is a medicine in great repute for the bite of the Cobra de Capello, called the *snake-pill* †, which is said also to be a specific against CANINE MADNESS, which disorder deserves *here* to be considered. We have a very accurate description of the symptoms of *hydrophobia*, or as it is more properly called rabies contagiosa, by Dr. WOLF, in five cases of persons who died of this dreadful disease.

The eye, as in typhus fever, is impatient of the least light; any bright colour creates uneasiness; the mind is very irritable; the best friends are disliked. It is remarkable that the lint, or other dressings, when taken off discover a *black surface*, even though the wound may

\* Now the dawn of a probable theory has broke in upon us, we are able to distinguish the operation of these two bodies, which destroy *contiguity of parts* in the living body from very different causes. The LUNAR CAUSTIC, as was said before, is *silver* combined with the *nitrous acid*, and that to the *oxygen* of that mineral acid it owed its powers (Vide Vol. I. p. 343). Now the FLUID VOLATILE ALKALI is *azot* and *hydrogen* (Vide Vol. I. p. 39), which has the strongest affinity for *fixed air* (*carbon* combined with *oxygen*), and by dispossessing from animal matter its *carbon* and *oxygen* it acts; for when previously saturated with *fixed air*, it has then no such property, but becomes *mild alkali*.

† This is composed of the *oxyd of arsenic* and a small portion of the *oxyd of mercury*.

discharge

discharge good pus; the fauces have *no appearance* of *redness*; the face, which at first is *pale*, becomes *brown*, and during each spasmodic attack turns almost quite *black*; the lips are extremely *livid*; as the disease advances each paroxysm is less violent; the patient has intervals of reason; the dread of strangulation from water goes off; the pulse becomes weak, quick, and fluttering; and the body feels remarkably *cold*; he then composes himself as it were to sleep, and expires. Upon dissection there is not to be found the *least trace* of *inflammation*.

From this appearance of things, have we not reason to expect some advantage from the inhalation of VITAL AIR? Opium, camphor, musk, and submerision, have from repeated trials justly lost their reputation in this disease \*. The abstraction of *oxygen* from the sys-

\* These remedies have been employed from considering this disease as purely NERVOUS. The nature of spasmodic *affections* and the *operation* of *opium* has not till of late been properly ascertained. Professors have taught that OPIUM allays *pain*, but they have not *distinguished* the *pain* of *inflammation*, and that arising from a state of *asthenia*. In the former, or *sthenic diathesis*, it *augments* the *pain*, and *incapacity* for *sleep*. Vide Vol. II. p. 332. In the latter *opium* removes *pain*, because it *removes* by its *stimulant operation* its *cause*, and thus *predisposes* to *sleep*. *Brandy* and *wine* in such cases would produce nearly the same operation. This is the *discovery* of the author of the *Elementa*, Dr. BROWN. Vide Vol. III. p. 465.

tem by immoderate exercise \*, is also found to be no remedy, and in dogs it is the symptom of the disorder. It may be said, that the *oxyd of mercury* † has been administered in this disease, and without advantage; but as far as I have read, it has been constantly in such cases accompanied with musk, bleeding, opium, or camphor. But whether in this alarming disorder it be better to oxygenate the blood or not when the disease has taken place, as *prevention* is always better than *cure*, it should occupy most of our attention.

When the contagion of a putrid fever is taken by the saliva into the stomach and bowels, which is its constant road, if the patient, the moment he finds himself attacked with a sense of chilliness, loss of appetite, and an unpleasant taste in his mouth, has re-

\* This is recommended by John HUNTER, because a man in hydrophobia ran three times round Smithfield, and exhausted by the fatigue, seemed for a while relieved! Vide John HUNTER's Dissertation on *Hydrophobia*.

† M. MATHEU, after bleeding and purging, excites as soon as possible *salivation*. He says, "the *hydrophobia* yields, as it were, by enchantment, " when the *salivation* appears; and it must be kept up according to the degree " of the disease and the strength of the patient." The illustrious SAUVAGE, speaking of *Mercury*, declares, " *apres bien de recherches*. L'ignore que ce " remede ait encore manqué, étant, meme appliqué quand le rage étoit de- " clarée." "After many enquiries, I know not," says SAUVAGE, "whether *mercury* has ever failed, even when the hydrophobia had commenced."

course

course to two emetics at proper intervals, and after the operation of the first emetic, takes a cathartic, he has certainly got rid of the infection: in the same way, even after three days, or perhaps a week, if the part bitten by the dog be cut out with the knife, the danger is escaped. But sometimes it will happen that the patient will not submit to this operation, or to the application of the *lunar caustic*, which perhaps may be *preferable* to the knife, and it then becomes an object of enquiry, what next should be done? This was the case three years ago. Five men were bitten by a dog supposed to be mad, and which was shot. The village doctor, who knew in this disease nothing beyond the knife \*, finding his patients refuse the operation, had recourse to Dr. THORNTON's advice. This physician recommended the application of hot *vinegar* sharpened with *vitriolic acid*, the wounds being first scarified, and the events turned out favourable. Are the *mineral* and *vegetable acids* correctors of this poison? Or in these five cases did the cloth prevent the insertion of this poison? In this age of investigation this will, in all probability, be soon fully ascertained.

\* "Immedicabile vulnus ense recidendum est."

Nothing, says Mr. HUNTER, would probably contribute so much towards our obtaining a proper treatment of *hydrophobia*, as experiments made with the poison. It is true the undertaking would be both difficult and hazardous; yet the danger is perhaps greater in apprehension than it would be in reality. Dogs known to be mad are often confined till they die; and in this state there would be no great difficulty in collecting a portion of the saliva, or poison. The point of a lancet would probably introduce the infection as certainly as the tooth of the dog. By experiments upon dogs, the several stages of the disease might be known, the latest period at which the contaminated part could be cut out with success, might be ascertained; and various *counter-poisons* might be applied to the wound, or administered internally\*.

\* The *oxygenated marine acid* certainly deserves to be tried here, as well as the *oxyd of manganese*.

## SECT. LIV.

## OF ASPHYXIA FROM LOSS OF BLOOD.

Ye shall eat the blood of no manner of flesh; for the *life* of all flesh is the blood thereof.

LEVIT. xvii. 14.

WHEN swooning arises from a small loss of blood, it will be necessary to leave the patient in that state: for the *accumulated irritability* will soon supply the sudden loss of so powerful a stimulus. But when the loss of blood has been great, TRANSFUSION then furnishes the only hope.

The first hint of this great attempt was given at *Oxford*, Anno 1658, by Dr. CHRISTOPHER WREN, Savilian Professor of Astronomy there, who proposed, to the honourable Mr. BOGLE, a method of TRANSFUSING LIQUOR into the veins of living animals.

In 1666 his hint was farther improved, at the same constant source of ingenuity and learning, by Dr. RICHARD LOWER, who invented the method of TRANSFUSING BLOOD out of one animal into another.

He was followed by several ingenious men at *London*,  
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and particularly by Dr. EDMUND KING, who rendered LOWER's method of transfusion still more easy and commodious. And as it was intended by the *Royal Society* that those trials should be prosecuted to the utmost variety which the subject would bear, by exchanging the blood of old and young, sick and healthy, fierce and timid animals; various experiments were accordingly made with surprising effects upon lambs, sheep, dogs, calves, and horses, &c.

From *England* this invention passed into *France* and *Italy*, where, after old and decrepit animals had the agility of their limbs restored by the transfusion of young and healthy blood into their veins, and other wonderful things had been achieved, J. DENIS, doctor of physic, at *Paris*, with the assistance of Mons. EMERETZ, ventured to perform the operation on men in that city; and J. G. RIVA, a surgeon of great reputation, made the same experiments at *Rome*.

After some trials, Mons. DENIS published an account of a young man, that was cured of an uncommon *lethargy*, by transfusing the arterial blood of a lamb into his veins: and another account of the cure of *madness* performed on a man 34 years old, by transfusing the arterial

terial blood of a calf into his veins, in the presence of several persons of quality and learning.

This daring enterprize having succeeded so well at the first setting out in *France*, it was also practised in *England* from the arteries of a young sheep, into the veins of ARTHUR COGA, Nov. 23, 1667, at Arundel-House, before a splendid company, by Dr. EDMUND KING, and Dr. RICHARD LOWER. And COGA published, under his own hand, an account of the *great benefit* which he received from the operation.

The illustrious HALLER observes, in his *Physiology*, that by transfusion of arterial blood, the whole machine of the animal is thereby endowed with a remarkable degree of *vivacity*.

Unfortunately this operation was performed on BARON BOND, the son of the first minister of state in Sweden, who had an *inflammation*\* of the bowels, and was given over by his physicians, and soon after on a person in a *consumption*†; which cures turning out unsuccessful, the  
*practice*

\* Nothing could be more imprudent than this trial.

† It is remarkable, that the *first trial* of the VITAL AIR was made in this fatal disease in *France*; it gave temporary benefit, and spread, as CHAPTAL says, “*Flowers over the borders of the tomb*,” but hastening on the mourn-

*practice* being yet in its infancy, and unsupported by sufficient documents, it fell into *discredit*, and was prohibited by the KING'S AUTHORITY in *France*, and by the POPE'S MANDATE at *Rome*.

Thus was defeated a noble essay, begun with prudence in *England*, but imprudently pursued in *France* and *Sweden*, which, had the first trials on the human species been conducted with care and caution, might in time, says Dr. MACKENZIE, have produced most useful and surprising effects.

The introduction of the *vital air* into the practice of physic has thrown great light upon this intricate question, and as, in TRANSFUSION, *venal* blood was removed while *oxygenated*, or *arterial* blood was supplied to the veins, the lungs the while imbibing the *vital air*, the constitution was made to *superabound* with *oxygen*; hence arose, as Dr. THORNTON observes in a letter to Dr. BEDDOES, all the surprising phenomena of TRANS-

*ful event* it was soon abandoned, and had not the ingenious Dr. BEDDOES and his coadjutors, Dr. DARWIN, Dr. EWART, Dr. THORNTON, &c. been conducted by a *rational theory*, which they have confirmed by *practice*, the AERIAL REMEDIES had probably met with the same fate as TRANSFUSION. Vide Dr. BEDDOES'S *Observations*, p. 127. Also the *Appendix to his Considerations*, being CASES IN ELUCIDATION OF THE MEDICINAL EFFECTS OF FACTITIOUS AIR.

FUSION:

FUSION\*: but in the present instance, it acts also by *distention*, and the utmost care must be taken to adjust the right quantity of blood †, which must be done by carefully noting the alteration of the pulse.

\* Vide the Letters of Dr. WITHERING of Birmingham, Dr. DARWIN of Derby, Dr. THORNTON of London, &c. to Dr. BEDDOES.

† When this experiment was made some years back at *Cambridge* by professor HARWOOD, the blood of a *sheep* was transfused into the veins of a *pointer*, who was previously bled; and more *arterial blood* being admitted than was *proper*, the animal sensible of *plethora* immediately set about eating *grass*.  
‡ An old bed-maker who happened to be present cried out, “ Lord, Maister, “ your dog is already turning into a *sheep*!” In other trials, the animal after the operation has wagged his tail, forgiven his matter, and seemed, if any thing, *more lively* than usual. Vide a very *important experiment* of this nature recorded in Vol. I. p. 126.

END OF THE THIRD VOLUME.









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